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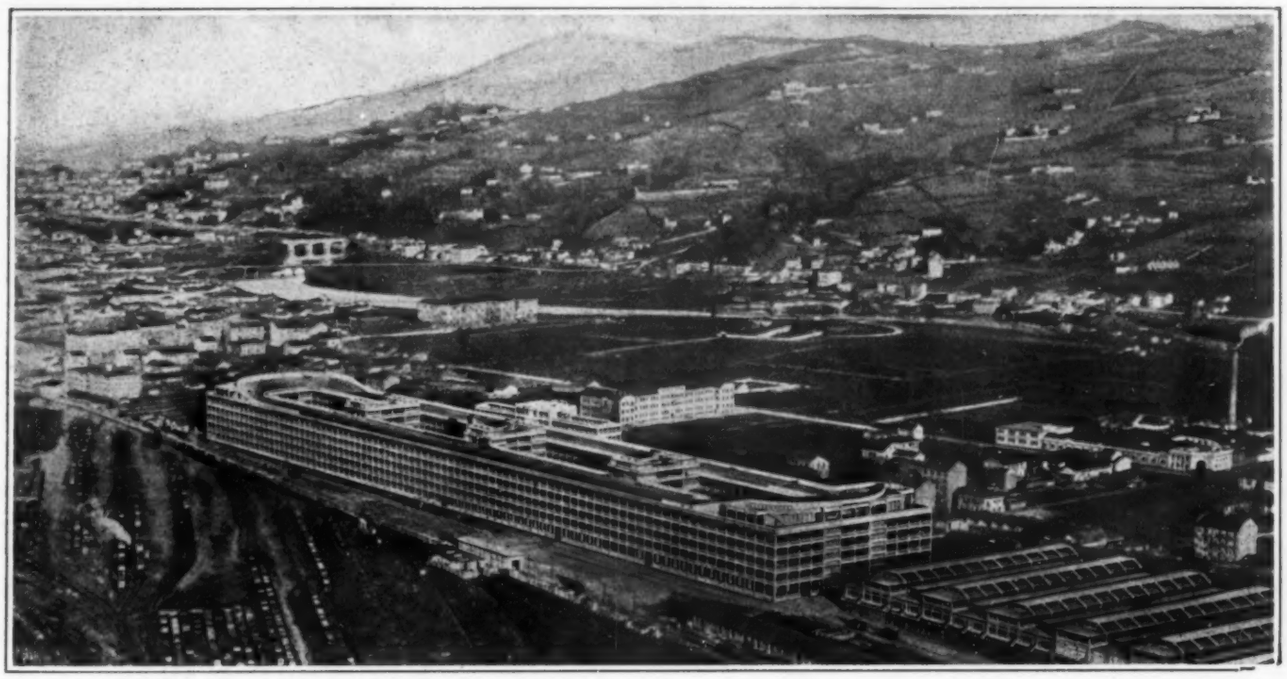


The Impressive Story of Fiat

By J. A. Lucas and F. E. Bardrof

The Plants and Their Products

IN THE mind of the average American the name Fiat is linked with a foreign automobile, considered to be above the average in beauty of design and mechanical construction as well as in price. We hear periodically that one of these cars has successfully upheld its reputation in one of the European races, but most of us have little conception of the modern, well-organized plants in which these remarkable cars are made.

The Fabbrica Italiana Automobili Torino, Fiat's real name, is more than an automobile plant and presents a multitude of interesting features and developments to the American observer. First, its size compares favorably with the largest in the world. Second, it is developing its production scheme to handle a great many of its products from the procurement of the raw material to the finished machines. Third, its machine shop practice is entirely up to date and compares favorably with American methods. This has been brought about through close observation of American automobile production developments and the use of considerable quantities of American machines, but the co-ordination of the work and the fine results obtained are Fiat accomplishments pure and simple. Fiat has not followed blindly but has adapted much of our best to its needs, completing its industrial program by individual developments which merit careful study by American shop men.

The majority of the activities of Fiat center in and about the city of Turin, Italy. Turin is located on the river Po in the extreme northwestern part of Italy, a short distance from the French frontier. The city lies at the foot of the western Alps about 75 miles west of Milan, and is the first station of importance after passing through the Mont Cenis tunnel from France.

The Fiat plants are distributed throughout the city and its environs and are particularly interesting to the American visitor, who cannot help but look with a considerable feeling of pride upon the batteries of American machine tools in use on automobile production and the application of modern production methods similar to those developed in this country. The map of Turin shown in Fig. 1 gives the location of the plants in and about Turin.

The largest and most modern of the plants is the Lingotto plant, used entirely for the manufacture of the Fiat motor cars, and located on a level tract of ground in the southern part of the city between the

Fig. 1—Fiat plants in and about Turin, Italy

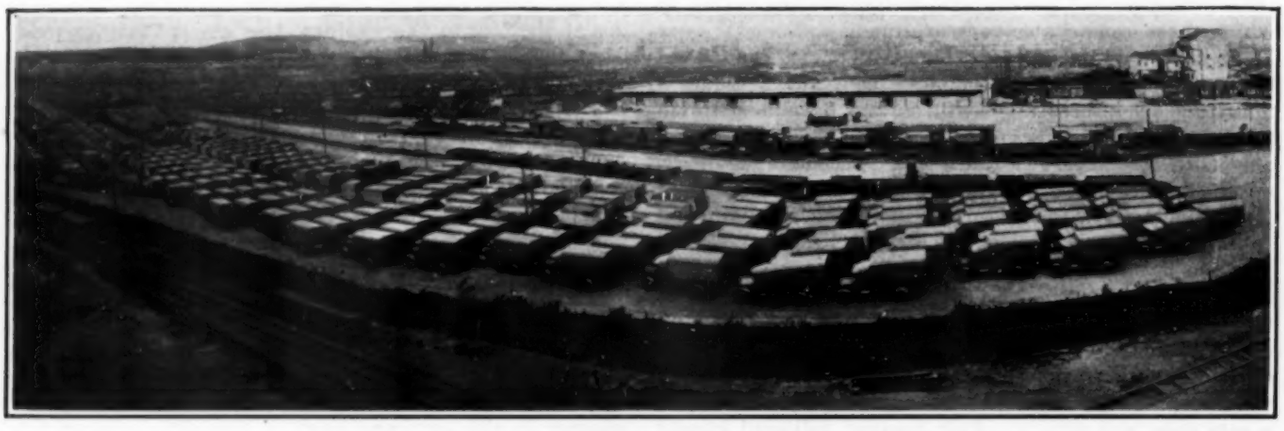


Fig. 2—One day's production of commercial vehicles

railroad to Genoa and the river. An airplane view of this plant forms the headpiece of this article and gives some idea of its size and general construction. On the roof of this building is located the three-quarter mile track where all cars are given a thorough road test before being shipped. Of this plant and the operations performed in it we shall provide detailed information in later articles.

The Fiat company originated in 1899 and by extending the scope of its activities and its productive ability was formed into a stock company in 1906. Since that time and especially during the war, it absorbed several other shops and manufacturing establishments until it is now without doubt one of the leading automobile manufacturers of Europe. The industrial, mechanical and metallurgical establishments of the company now

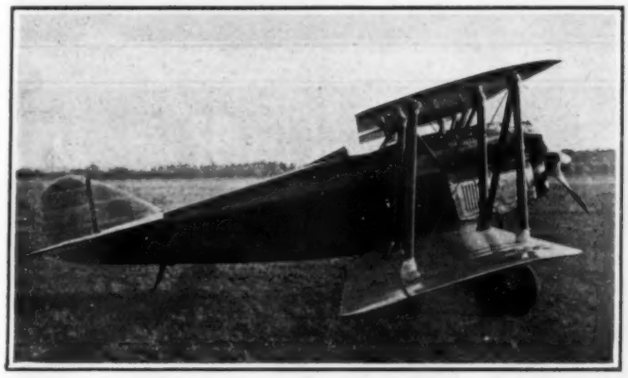


Fig. 4—Fiat hunting plane

embrace more than 20 large plants, in which are provided approximately 420 acres of floor space. These plants furnish employment for more than 26,000 persons, many of whom are leaders in their fields.

Motor trucks, motor buses and other commercial cars are also made in addition to the manufacture of so-called pleasure cars, the original Fiat shops in the Corso Dante being used for this purpose. The shipping station for these vehicles is shown in Fig. 2, with one day's production ready to be loaded.

Another group of plants of great importance in the Fiat industries are the steel and iron foundries and mills but the detailed description of these will be given later. These mills and the forging, stamping and rolling mills are equipped to furnish the raw material for all the Fiat industries and the recent acquisition of large mining properties allows the company to control its working materials from mine to finished machine. Few of us have realized that the Ford plan has a counterpart in Italy.

Of the products of this company we have mentioned only automobiles, and of these the model-510, 6-cylinder, 20- to 30-hp. limousine shown in Fig. 3 is a good representative. Most of the other products of the company are not manufactured on such a quantity basis but their variety is surprising.

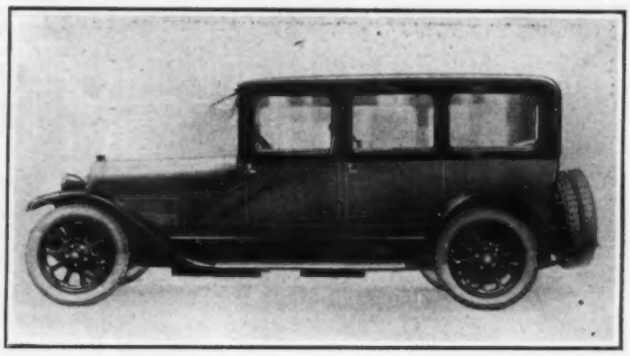


Fig. 3—Fiat model 510, 6-cylinder limousine

For instance, Fiat is among the leaders in the manufacture of airplanes and airplane motors and in Figs. 4 and 5 are shown a hunting plane and the Fiat, 12-cylinder, 700-hp., aviation motor, respectively. Other products are motor boat engines, and marine Diesel engines up to 6,000 hp.; caterpillar tractors and tanks; four-wheel tractors for agricultural and other uses; stationary and portable oil engines and ships up to 11,200 tons in size. The latter are built in the seaport town of Spezia and are motored by Diesel engines. In addition to the above there are four shops in Turin in which are manufactured each year thousands of freight cars and passenger coaches for railroads. These railroad car shops employ about 2,000 workers and form an important part of the Fiat group.

Another group of shops, Villa Perosa, Pinerolo, and Via Nizza, are equipped for the manufacture of ball bearings of every description, small tools, precision machinery and firearms. About 70 per cent of the output of the ball bearing shop is exported to America and the manufacture of these bearings will be taken up in detail later. In connection with this group are

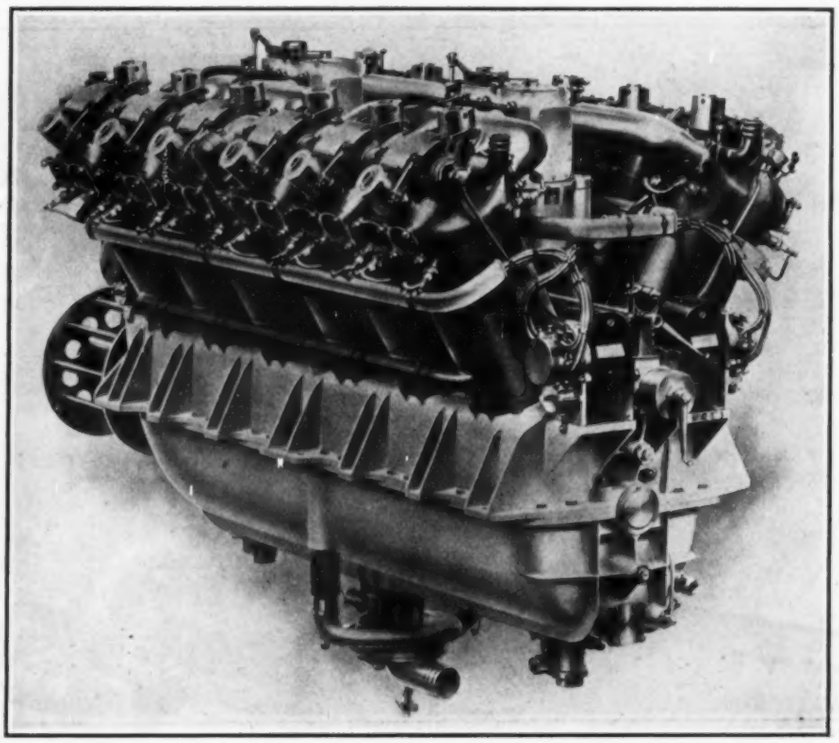


Fig. 5—Fiat 12-cylinder, 700-hp., aviation motor

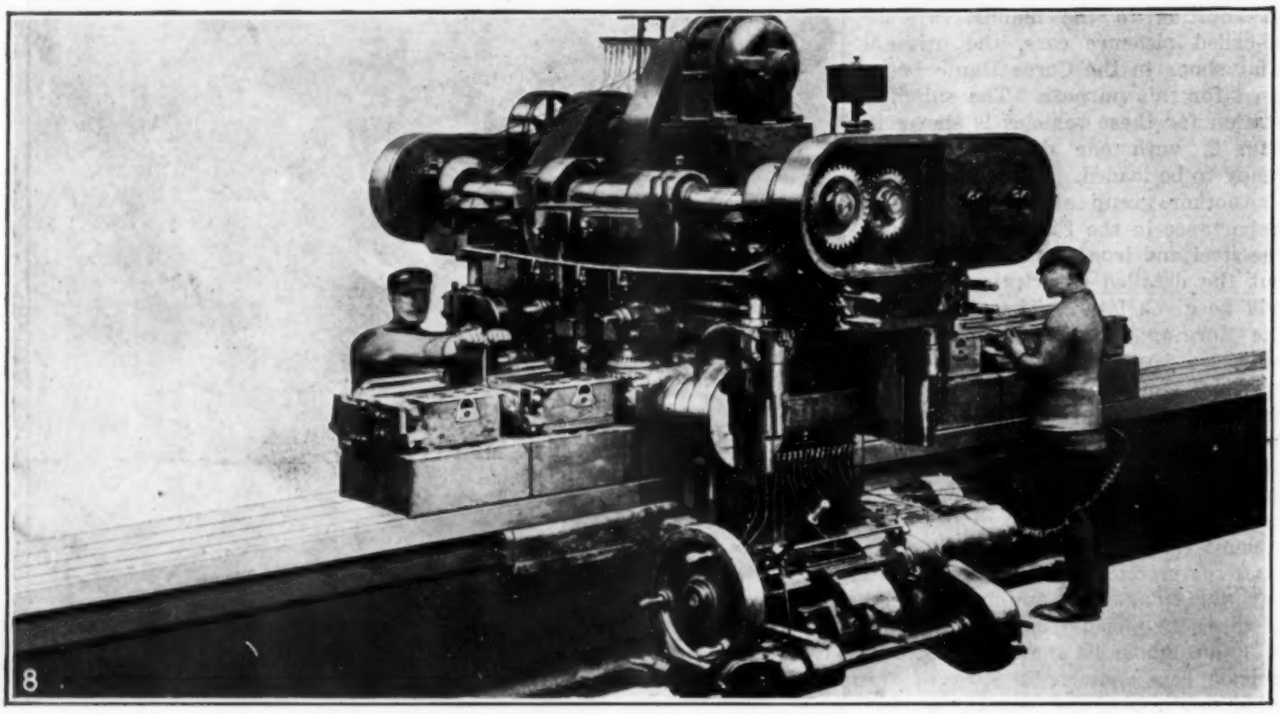


Fig. 6—Niles-Bement-Pond planers and Baker Bros. rilling machines. Fig. 7—Hendey lathes
Fig. 8—Ingersoll production milling machine

lunch rooms, nurseries, bakeries, workmen's homes and stores for various merchandise. All these were built and are maintained by Fiat for the welfare of its workers, and food, homes, goods and general merchandise are provided at absolute cost.

The selling organization is composed of twelve branches in Italy, six branches with service stations in foreign countries, and over 800 agencies throughout the world. The main export market for pleasure cars is in Great Britain at the present time, the American market being curtailed by the heavy duty of 45 per cent.

It seems rather strange that the latter fact has not worked against the installation of American machine tools, but a large number of American tools are in use, especially in the Lingotto plant on automotive parts production.

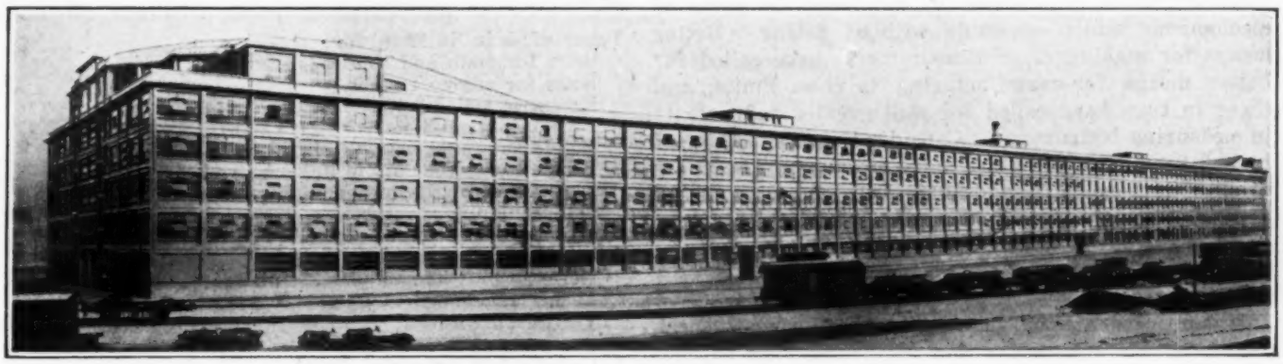
The two planers shown in Fig. 6 are at the end of a battery and are from the Niles-Bement-Pond shops, Plainfield, N. J. Beyond the planers can be seen a line of drilling machines manufactured by Baker Bros., Toledo, Ohio.

The dozen lathes lined up in Fig. 7 will be easily recognized by practically all American shop men as the product of the Hendey Machine Co., Torrington, Conn. From this picture and the one preceding, it is apparent that the individual motor drive which is becoming so popular in America has not received much consideration by the engineers of this company.

The Ingersoll production milling machine, shown in Fig. 8, is one of a battery used for machining the cylinder blocks and, contrary to the evidence of preceding pictures, is motor-driven. These machines are of the planer type, the block castings being held in fixtures during the machining operations.

These illustrations serve to show the part which the American machine tool plays in this great Italian plant, and are also perhaps an indication of the large place that industrial America is destined to fill among the manufacturing groups of Europe. It takes no great stretch of imagination to observe the trend in this direction. The machine builder, and the machine user as well, can focus their attention with a good deal of profit on the European automotive developments as exemplified in the Fiat plants.

However, Fiat is interesting in a great many ways aside from its adaptation of American ideas. Its managers are awake to their opportunities; its workmen are skilled; its engineers show originality in development and research; its plants conform to the requirements of modern manufacturing methods; its organization functions smoothly and with exceptional results. Italian engineers hold an enviable position in mechanical pursuits throughout the world and in studying the Fiat establishments we are able to get an illuminating view of the practical application of their ideas and theories.



The Lingotto plant where Fiat cars are fabricated

Carbon Monoxide Test

The dangerous fallacy that the atmosphere in a closed garage is safe as long as an automobile engine continues to function has been disproved by a test conducted by engineers of the Interior Department at the Pittsburgh Experiment Station of the Bureau of Mines.

An ordinary touring car which is operated daily, was run into a brick garage having a capacity of approximately 3,000 cu.ft., a dog was placed upon the driver's seat, and the engine allowed to continue running at an idling speed. The doors of the garage were closed, and after 20 minutes operation of the engine, the dog lost consciousness and fell to the floor of the car. An analysis of the air at this time disclosed the presence of 1.3 per cent of carbon monoxide, which is sufficient to cause unconsciousness and death in a few minutes. The automobile engine was allowed to run until it stopped from lack of air, which occurred at the end of two hours when the percentage of carbon monoxide present in the garage atmosphere was indicated as 2.1 per cent, an almost instantaneously fatal amount.

The engine functioned six times as long as the dog retained consciousness, proving conclusively that the continued operation of an automobile engine in a closed garage is no indication as to the condition of the air and that the engine will continue to function long after the operator has lost consciousness. This experiment was conducted in a garage, several times as large as the average one-car garage and it is safe to assume that a dangerous concentration of carbon monoxide would result in a one-car garage in less than half the time recorded in this experiment. In other words, the dog would have lost consciousness in about ten minutes after the starting of the engine, which would have continued running for about one hour. The Bureau of Mines calls attention to the great danger of anyone entering a closed garage for the purpose of shutting off a running engine. It is quite certain under such conditions that dangerous concentration of carbon monoxide will occur in a very short time if the garage is closed and when the motorist returns he is likely to encounter an atmosphere sufficiently charged with carbon monoxide to render him unconscious in two or three minutes and to cause his death if he is not promptly rescued from the deadly fumes.

Some Limitations on Manufacturing to Close Limits

By B. H. Blood
General Manager, Pratt & Whitney

IN MANUFACTURING to limits the first essential is to be able to measure, not merely to those limits but much more closely. The great majority of manufacturing operations in metal consist in removing surplus stock. To hold to any specified limits it is only necessary to stop at the right point. Our means of measuring must show us how closely we are approaching that point, and warn us before we pass it.

Thirty years ago very few machinists had ever seen a micrometer. Close dimensions were expressed on drawings in sixty-fourths of an inch. A drawing with sizes and tolerances expressed in thousandths would not have been intelligible. Yet the skilled mechanic worked in thousandths without knowing it. He would produce a drive fit, a sucking fit, or a running fit that was entirely serviceable, if he had the nicety of touch and the patience to do it. It took skill and time. He did not even aim at interchangeability. However, the general adoption of the micrometer, perhaps our most useful measuring instrument, has changed all this. The skilled mechanic has become the toolmaker and devotes his time and skill to providing the means whereby the unskilled operator produces by hundreds the parts of mechanisms which assemble without fitting. Better means for making close measurements have called for better means for manufacturing to close limits, and these in turn have called for still greater refinements in measuring instruments. Consider the steel balls used in ball bearings. They are made in quantity to limits of one ten-thousandth, and again selected by variations of a quarter of a ten-thousandth. This could not be done by the aid of micrometers alone.

Fine Gage Work

It is unfortunate that many people have come to speak familiarly of thousandths and ten-thousandths without any conception of what those quantities mean in metal. Take, for example, a ring gage, nominally one inch. By holding it in the hand a few moments it can readily be warmed 16 deg. F., which would expand it a ten-thousandth. Take also a plug which fits the gage very freely—so that it can be felt to shake—and place a strip of cigarette paper one-quarter inch wide and one-thousandth thick, between the plug and the ring; the result will be a tight fit. Take another plug which will just drop through the ring by its own weight, and a third plug, which is just half a ten-thousandth larger, will fit so snugly that it will not shake off. A fourth plug, whose diameter is greater by another half ten-thousandth, will not enter the ring dry. By coating the surfaces with light oil the plug will enter the ring and slide freely as long as it is kept moving, but when it is allowed to come to rest for a moment the two are apparently frozen together, and cannot be broken apart.

There are no satisfactory means for measuring the diameter of this ring except by measuring the diameter of a plug on which the ring fits. But which one of these plugs does the ring fit? It must be that the oil film has some thickness, and yet the plug would not enter the ring without oil. It appears that the ring is actually stretched by the oil film.

This illustrates the difficulty of manufacturing to close limits when we have no direct means for measuring. We frequently send out plug and ring gages which have a "freeze fit," and the customer returns them claiming that the ring is smaller than the plug because he cannot get them together. The plug is capable of direct measurement, and measurements by different operators and in different laboratories, using different instruments, will agree more closely than some would believe. But who can say what is the inside diameter of this ring? We can expect no agreement on this point. Yet draftsmen will calmly place on their drawings tolerances which cannot possibly be checked, and leave the gage maker and the inspector to fight it out. Too often this is done conscientiously, in the belief that high-class work is thereby assured.

An excerpt from a paper presented at a joint meeting of the Engineers' Club of Philadelphia, Philadelphia Local Section and the Machine Shop Division of the A.S.M.E., at Philadelphia, Pa., on March 25, 1924.

Taper Fits in Locomotive Work

By Clifford H. French

There are several different tapers used in locomotive work, the tapers varying from $\frac{1}{8}$ to $1\frac{1}{2}$ in. to the foot. The Santa Fé system has adopted the following standards:

Taper of $\frac{1}{8}$ in. in 12 in. for:
- Bolts for main and side rods.
- Bolts for engine frames.
- Eccentric splice bolts.
- Eccentric strap bolts.
- Eccentric crank bolts.
- Long reverse-yoke pin in Baker valve gear.

Taper of $\frac{3}{4}$ in. in 12 in. for:
- Bell-crank pin.
- Combination-lever pin—long.
- Link-block pin.
- Reverse-shaft hanger pins, Stephenson gear.
- Rocker-arm pins in single shear.
- Valve-stem sockets.

Taper of $\frac{1}{2}$ in. in 10 in. for:
- Combination-lever pin—short.
- Connecting-rod pin—top and bottom.
- Connecting-rod pin bushing—center.
- Eccentric-rod pins.
- Piston-rod fit in crosshead.
- Piston-rod fit in spider.
- Reach-rod pins.

Reverse-shaft hanger pins—Walschaert gear.
- Reverse-yoke pin—short—Baker gear.
- Reverse-gear piston fit in spider and in crosshead.
- Radius-bar pin.
- Rocker-arm pins in double shear.
- Union link pins.
- Valve-rod knuckle joint pins.
- Valve-rod pins.
- Valve-stem crosshead pin.

A taper of $\frac{3}{4}$ in. in 12 in. is used for the eccentric-blade pins and of $\frac{3}{4}$ in. in 10 in. for the center connecting-rod pin.

A taper of $1\frac{1}{2}$ in. in 12 in. is used for crown-bar bolts where they fit in the crown sheet. The same taper is used for side-rod knuckle joint pins.

The Santa Fe railway shops have standardized line shaft speeds as follows: Blacksmith shop, 185 r.p.m.; machine shop, 225 r.p.m., and woodworking shops, 300 r.p.m.

How to Estimate Machine Shop Costs

By Albert A. Dowd

Second article—Determination of machining time and total estimate for simple parts—Estimate sheets—Importance of reference data—Reference sheets for machine tools

IN ORDER to give to the reader some idea of the process of estimating as applied to very simple work, two pieces are shown in Fig. 2 at *A* and *B*. The part *A* is a stud made from cold-rolled steel and requires only one operation to complete the piece. The other example *B* is of cast iron, but it is finished all over. Great accuracy is not required on either of the two pieces, as will be seen by referring to the limits specified. For work of this kind an elaborate estimate is entirely unnecessary and, although some factories may insist upon the use of regular operation and time study sheets, the writer's experience indicates that nothing of this sort is needed for work of so simple a nature.

In Fig. 3 is shown a simple form of estimate sheet

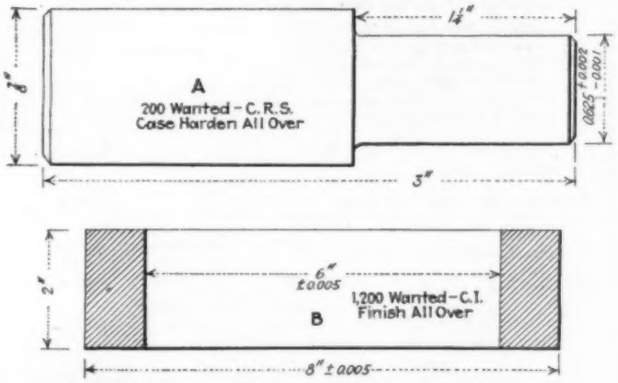


Fig. 2—Two simple examples of machine work

made out for the part illustrated in Fig. 2 at *A*. The heading of this sheet is the only part that is printed, the remainder being left blank. The customer's name and address, the estimate number, and the date, together with other necessary information, are given at the top of the sheet as shown. The estimator writes the entire estimate on the sheet, specifies the various operations, tools and material needed, and also estimates the time required for the various operations.

The figuring of feeds and speeds, and other matters intimately associated therewith, will be taken up in detail later, and for the present it is only necessary to give a little general information on the subject. The estimator, knowing the class of material which is to be cut, first establishes a suitable cutting speed and decides upon a conservative feed for the various operations. The particular job shown is a short one and care must be taken to make the time allowances great enough to cover the work from start to finish, including the setting up of the machine, and grinding tools and re-setting them, as well as contingent time for feeding stock, indexing the turret, etc.

Assuming a cutting speed of 80 ft. per min., the estimator finds by reference to his machine data sheets, that the nearest spindle speed is 365 r.p.m. He decides upon a feed of 0.020 in. per revolution and, in order to simplify the calculations, the time is figured in decimals of a minute by means of the following formula:

$$T = \frac{L}{FR}$$

in which T = Cutting time in minutes
R = R.p.m. of work
F = Feed
L = Length of cut.

Substituting the numerical values

$$T = \frac{1.25}{0.020 \times 365} = 0.17 \text{ min.}$$

This is the time required for the first operation on the work and the other time estimates are worked out in the same manner, according to the speeds and feeds assumed. In cutting off the piece, the time allowance takes into consideration the fact that the cutting off tool is started when the second turning operation begins.

After all allowances for indexing and feeding stock have been made, we find that the total machining time for one piece complete is 0.77 min., and this time is multiplied by 200 to give the total time required for the actual machine operations. The allowance for setting up the machine increases the total number of minutes to 274, which is approximately five hours, and the labor cost is then determined. The labor charge per hour is fixed by the cost department and includes all overhead expense. The material used for 200 pieces, allowing ⅛ in. on each piece for cutting off, is found to be 160 lb., and the cost of this is added to the labor charge together with a 25 per cent allowance for profit.

In the estimate shown in Fig. 4 the castings for the part *B*, Fig. 2, are furnished by the customer so that there is no charge for materials. A notation is made, however, at the head of the estimate that the material is assumed to be good quality cast iron, pickled and annealed, to permit a cutting speed of at least 50 ft. per minute. As in the preceding estimate the machine to be used is specified, and the time estimate is worked out in the same manner.

In the factory it is important that the workmen should be provided with a proper tool equipment, in order that the work shall be done efficiently. So also in the estimating department, it is essential to have

The first article of this series was concluded on page 568, Vol. 60, No. 16.

reference data of all kinds, so arranged that it is readily accessible and up to date. In any factory prepared to manufacture mechanical devices in quantity, all the available production machines should be numbered, and each machine should be listed on a separate card for use in the estimating department. It will generally be found an advantage to expend considerable labor and care in the preparation of the machine cards, for complete data will save a great deal of time in the long run and will eventually prove economical, although the first cost may appear excessive.

Preparation of Machine Reference Cards

There are two methods for the preparation of these reference cards, and one of these is to clip the specifications of each machine from catalogs, pasting these clippings on suitable cards, with or without a cut of the machine itself. A much better way, however, is to make up tracings in diagram form, showing the portions of the machines to which tools and fixtures are applied, and giving essential dimensions, speeds, feeds and capacities, in tabulated form. The first method is much the simpler, but it is not usually complete enough for accurate estimating work, nor is it of much use as a reference for other departments. The second method allows the collection of blueprints made from the tracings in book form, so that each estimator can have a complete file at his fingers' ends. Other departments, such as the planning and engineering organizations, can also make use of the books or cards for reference in their own work.

In order to illustrate the relative value of the two systems mentioned, Figs. 5 and 6 are given. Fig. 5 shows a card of suitable size, ruled in uniform style and designating the type of machine, the size of machine, the manufacturer's name, the shop number and the number of the department where the machine is located. The specifications as given have been clipped directly from a catalog and several of those which are unimportant have been crossed off. At the bottom of the sheet a place is reserved for notes and, in the example shown, a little information is given regarding the equipment on hand. Any other details of importance may be noted here and it may be wise, if the machine is old, to note its condition and whether it is in need of overhauling before it can be used for accurate work.

The objection to this form of reference sheet is that there is only one for each machine and, in a large estimating department, each engineer would be obliged to make up something of the kind for himself, a proceeding which would naturally involve considerable labor and the mutilation of a number of catalogs. In addition, the information given in the catalog is seldom complete enough with respect to feeds and speeds and, although these points can be readily ascertained from the shop foreman or other sources, the collection of the necessary data takes time and is expensive.

Any factory engaged in contract work in sufficient quantity to warrant the organization of an estimating department, will find it a decided advantage to use a data sheet carefully made on tracing cloth, as shown in Fig. 6. When sheets of this kind are prepared for

CUSTOMER Phoenix Mfg. Co. EST. NO. 1430
ADDRESS Bankville, Ohio DATE 4-17-1921

PART NO. R-327 NAME Hanger Stud-Front-R.H.
DWG. NO. C-1620 MATL. C.R.S. NO. REQD. 200

Make from bar stock on 1" B and S. mach. Accuracy required not great.

Op. 1 Hold work in 1" collet; rough turn $\frac{27}{64}$ with std. box tools. Speed 365 R.P.M.; feed, 0.020 Length of cut, 1⅝" Time 0.17 min.

Op. 2 Finish turn $\frac{7}{16}$ diam. Speed 420 - Feed 0.020 Time 0.15 min.

Op. 3 Cut off and chamfer. Start C.C. with 2nd op. turn 0.20 min.
Indexing and incidental movements 0.18 min
Allow for feeling stock 0.10 min
Total time - 1 piece 0.77 min

0.77 x 200 = 154 min
Allow for setup mach. set tools etc. 120 min
Total 200 pieces 274 min
Allow 5 Hr. labor @ 1.50 $7.50
Material 160 lb. @ .08 12.80
$20.30
allow for profit 25% 5.08
Total $25.38

Fig. 3—Estimate sheet for part A, Fig. 2

CUSTOMER Bragg Bros EST. NO. 1432
ADDRESS Alpine, New Hampshire DATE 4-17-1921

PART NO. H-27 NAME Drum Spacing Collar
DWG. NO B-426 MATL. C.S. NO. REQD. 1,200

Castings furnished by customer - assumed good quality C.S., pickled and annealed to permit cutting speed of at least 50 ft. per minute. Use 16" swing tur. lathe-chucking equipment.

Op. 1 Hold work by outside in std. chuck jaws; rough bore with std. tool in turret; rough face at same time with C.S. facing tool.
Speed, 25 R.P.M. } Time 2.0 min.
Feed, 0.040 per rev. }

Op. 2 Finish, same as above
Speed, 30 R.P.M. } Time 1.66 min.
Feed, 0.040 per rev. }
Allow for set up and remove work .75 min
Total 4.41 min.

2nd setting: Hold by inside - soft jaws.
Allow same time as 1st set 4.41
Total for both settings 8.82
Allow 9 min

9 x 1200 = 10,800 min. = 180 Hrs
Allow for setup mach.
grind tools etc. - Total 12 Hrs.
192 Hrs.

192 Hrs. @ 1.50 = $288.00
Profit, 25% = 72.00
Total $360.00

Fig. 4—Estimate sheet for part B, Fig. 2

all the machines in the factory, the expense connected with the work is, of course, considerable and it involves a great deal of care and labor. The preliminary expense, however, is negligible when compared with the savings actually effected by having the data readily accessible, not only to the estimating department, but also to the planning and tool designing departments. The information should be given in as complete form as

TURRET LATHE
SIZE — 2" x 26"
MADE BY — P. & W. CO.

SHOP NO. — 368
DEPT. NO. — 12
EQUIPM'T. — CHUCKING

Specifications

2 x 26"

Range	~~Rod chuck capacity (rd.) (sq." (if moves) ... 2" (50 m/m)~~ ~~(sq. across flats) ... 1⅜" (30 m/m)~~ ~~(hex. across flats) ... 1⅛" (28 m/m)~~ across corners)
	Length, maximum turning . . . . . 26" (660 m/m)
	Swing over bed . . . . . 16" (406 m/m)
	Swing over cross slide . . . . . 8¾" (222 m/m)
	Threading capacity . . . . . 2" (50 m/m)
Turret	Hexagon, dovetail faces; 6 holes, 2¼" dia.
	Turret hole center to top of turret slide 3¾"
	Turret hole center to top of cross slide 3"
	Turret face to spindle end, maximum 33¾"
Spindle	Special steel, cylindrical bearings, front 3¾ x 5".
	Boxes, C. I., lined with babbitt, adjustable for wear.
	Hole through plunger . . . . . 2⅛"
	Hole through spindle . . . . . 2⅞"
	Front end, 4¾" dia., thread 5", 6 pi., U. S. F.
Speeds	Spindle speeds (27), r.p.m. . . . . 14 to 694
	Back gear ratio 2.57 and 7 to 1
	Cone on machine (3 steps) . . . . . 7½-9½-11¾"
	Cone on countershaft (3 steps) . . . . 9½-11½-13½"
	Pulleys (friction on countershaft) . . . 14 x 4½"
	Belt width (cone) . . . . . 3½"
	Belt width (countershaft friction pulleys) 4½"
	Countershaft speeds, r.p.m 120-235-385
Feeds	Turret slide, power longitudinal, 4 variations, r.p.sp. . . . . .007 to .02"
	Cross slide, power transverse, 4 variations, r.p.sp. . . . . .0012 to .0035"
	Cross slide, hand longitudinal, through screw and handwheel
	Rod feed, automatic positive power screw type.

NOTES: *Machine has chucking equipment only — no bar feed nor collets. 12"-3 jaw universal Cushman chuck also 2 jaw chuck, 9" diam., inserted jaws.*

Fig. 5—Reference sheet with catalog data

possible and a single sheet can often be made for several sizes of machines of the same make and type, using reference letters for the various dimensions and giving the data in tabulated form.

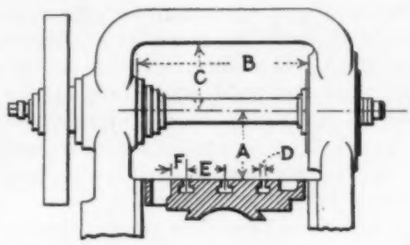
In the example shown in Fig. 6 a few letters have been used on the diagram in order to make the dimensions perfectly clear, and to simplify the wording in the text. Attention is called to the fact that the maximum and minimum feeds are the only ones given. It is much better to specify each feed separately but, since these are seldom given in a catalog, the information must be obtained from the shop foreman or from the feed table on the machine. The speeds may also be slightly different from those specified in the catalog due to variations in the line shaft speeds, or for some other reason. It is well to make sure of these matters before incorporating the figures in the table.

An endeavor should be made to give in the machine specifications all the data which may be required for estimating purposes, at the same time bearing in mind the importance of machine dimensions to the tool designing and planning departments, so that these departments may also be able to make use of the information given. The importance of reference data of

MILLING MACHINES—HEAVY DUTY—BRIGGS

MADE BY — BLANK MFG. CO.
TYPE "A"—TABLE — 36" x 8"

LOCATION — DEPT. 16
SHOP NO. OF MACH.-684



GENERAL SPECIFICATIONS		REMKS
Max. distance — A	12	
Max. table traverse	28	
Max. table adjustment — vertical	8½	
Distance between housings — B	12¼	
Clearance under overarm — C	6	
Cutter space on arbor	10	
Arbor — diameter	1½	
Cross adjustment — spindle sleeve	4	
Spindle — size of taper hole	No. 11	
Table — working surface	36 x 8	
T-Slots — width — D	⅝	
T-Slots — c. to c. — E	2½	
T-Slots — to edge of table — F	1⅜	
Feeds (δ) per revolution of spindle	0.008 — 0.038	
Speeds — spindle (4)	48, 58, 65, 80	
Speeds — countershaft — (2)	225 - 275	
Gearing — ratio	4 to 1	

Fig. 6—Approved form of machine data sheet

various kinds to the estimating department cannot be over-emphasized for the work of the department is greatly simplified by its use.

Screw Thread Standards Ready for Distribution

It has been announced by the Publication-Sales Department of the American Society of Mechanical Engineers, 29 West 39th St. New York City, that the American Screw Thread Standards for bolts, machine screws, nuts and commercially tapped holes will be ready for mailing on May 1.

This report has recently been completed by the Sectional Committee as a result of more than two years study of the report of the National Screw Thread Commission. A new set of standards is not presented in this report, but rather a unification and an extension of all existing standards by specifying limiting dimensions for the various sizes and pitches of threads already in general use. It also gives official sanction to certain processes such as over-sized drills which have long been established by common use.

Since the edition will be restricted to approximately the number for which ready sale is assured, all members interested in this report are urged to place their orders immediately.

The price of the report being dependent upon the size of the edition is not yet fixed, but it is the Society's aim to make the price for single copies and for lots of 25 and 100 low enough to enable every individual and industrial concern to use this publication freely in their work.

Breakage of Air Compressor Valves Reduced by Tempering

By H. Edsil Barr

Until comparatively recent years, the valves of air compressors were quite generally of the spring-seated poppet type, with a lift as much as one-quarter of the diameter of the valve orifice. The practical speed of compressors thus equipped was about 150 r.p.m. for machines of 10- to 12-in. stroke, higher speeds being undesirable, both because of the excessive noise of the poppet valves and because of the rapid drop in volumetric efficiency at higher speeds.

The so-called plate valve has effectively removed the bar to higher speeds, the reciprocating parts of modern well-built compressors being designed along lines of high-grade engine practice and well adapted to higher speeds. In present practice a speed of 220 r.p.m. for a 14-in. stroke machine, or even higher, is common.

The plate valve, a rather general designation of present compressor valves of various designs as used in the standard machines, is primarily a thin round plate, a rectangular strip, or some other form of thin plate which covers the valve orifice. This thin piece of spring steel is commonly attached to the valve cage in such a way that the steel will flex away from its seat by the action of the incoming or outgoing air, as the case may be. The lift is very slight, a large valve port area being provided to offset the low lift. The valve, forming its own spring, having little lift, and with but little weight seats instantly, and without rebound or noise.

New Type Valves Broke Frequently

However, there was difficulty in the use of the new type valves, as furnished in some otherwise first-class machines, evidenced by frequent breakage of the thin pieces of steel forming the valve proper. Careful research as to the best material for the purpose in some cases and redesign in others have reduced this breakage and, while the cost of the valves has not been the serious point, frequent shutdowns to replace broken valves has in many cases proven a considerable expense from lost service. The method by which this breakage in the case of one compressor was overcome, may be of interest to those still troubled in this way.

This particular machine has two stages and is depended on to supply the air for several important factory departments. When a valve broke the particular cylinder affected could be at once found by the effect on the intercooler gage, but in order to find which valve in that cylinder had broken it was necessary to remove valves until the broken one was found, the delay being many times more serious than the cost of the small steel valve itself. Considerable experimenting was done, with the result that by the simple process of drawing the temper in an electric oven, the breakage has been greatly reduced. Not over one or two valves have broken in the past three years of steady operation.

The spring steel valves were placed in a wire basket in the oven and drawn very slowly to about 720 deg. F., slow heating being important in the case of any such massed material because the pyrometer would otherwise show the required temperature before the entire mass was actually heated throughout. The valves were then permitted to cool in the closed oven. It was also found that the steel from which the valves were made, should not be of pronouncedly high carbon, but of ordinary spring steel, drawn as stated.

The same treatment has been of great value in making coiled springs which are rolled up cold. Occasionally a steel would be received which would show an excessive set in the finished spring under test, but by drawing the finished springs as above, the elastic limit is apparently greatly increased as well as the resistance to fatigue.

Are Machine Tool Builders Easy Marks?

By Entropy

A recent issue of the *American Machinist* is replete with articles that seem to indicate that builders of machine tools are being "worked" by people in other industries. One correspondent shows that wages are too low in the machine shops, another that machine men spend too much time doing other men's engineering for them.

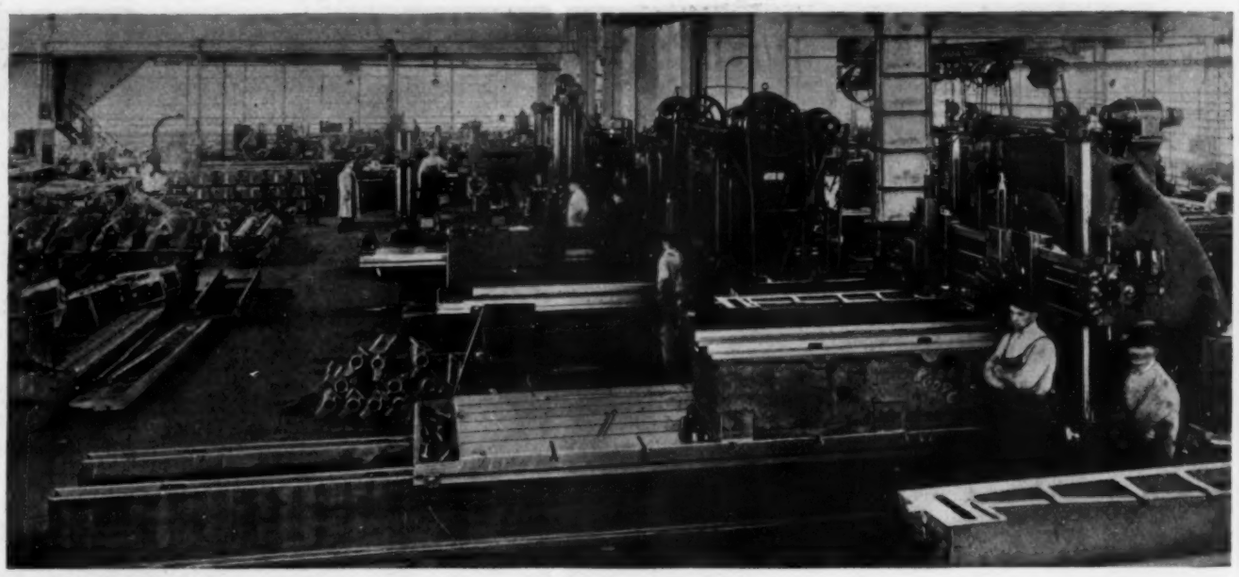
Is it not a fact that the average machine tool man is so much enchanted with his own work that he would rather work than eat? If he cannot get paid for his work he will work anyway. And he expects his employees to second him by working for comparatively little.

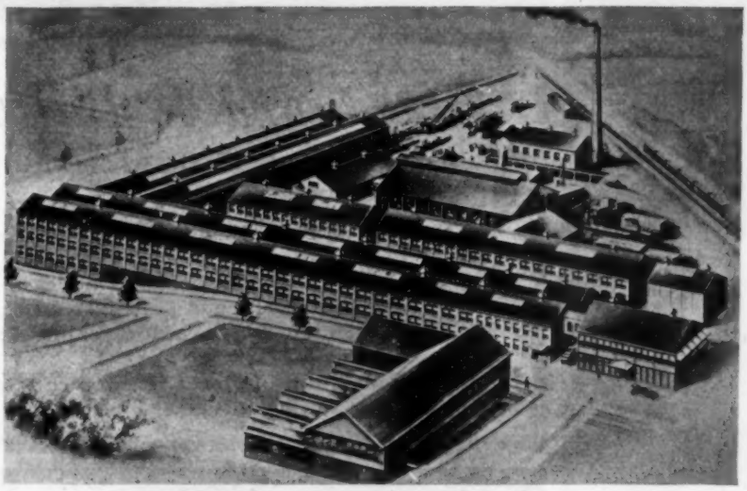
What other profession is there in which the engineering feature is so tied up with the manufacturing? Any man who has something that he thinks might be manufactured at a profit can get half a dozen firms tumbling over themselves to design machinery and make estimates, and then, if the prospects for profit fade away or capital is not forthcoming he can withdraw without a scintilla of responsibility. Why? Merely because if one does not do it another will.

There are two types of machine tool builders. One tries to do a strictly manufacturing business, the other is really an engineer who adapts his designs to the needs of the prospective purchaser. The firms that confine themselves strictly to manufacturing are few in number. Most of those that try to build only standard designs will go a long way to secure a substantial order for special modifications. The result is that builders are really more closely allied with engineering than with manufacturing. But there are no engineering charges made. Hardly any firms make a business of supplying designs for special machine tools. The two branches are merged in one.

I picked up a copy of the *American Machinist* at random. The first 25 advertisements of machine tools showed only two cases where the advertiser presented an argument that could be used to advocate buying his machine to replace an old one! The sales arguments were such as: "Second to none," "50 years experience," "Different from others," "None better," "Driving gears all steel," "Perfectly adapted" and so on. All undoubtedly true, but leaving a great deal to the imagination of the purchaser or the persuasiveness of the salesman. These advertisements, large and small, amount to mere professional cards, calling the attention of the purchasing public to the fact that these shops exist and that they are willing, if necessary, to provide machine tools.

Would not there be an advantage in building one of Chordal's brick walls between the manufacturing end of the shop and the high-brow, free-engineering section? Then the cost of the engineering would not be charged up against production and it would stand out so plainly that it is possible that the firm would decide to eliminate the "free" part of it.

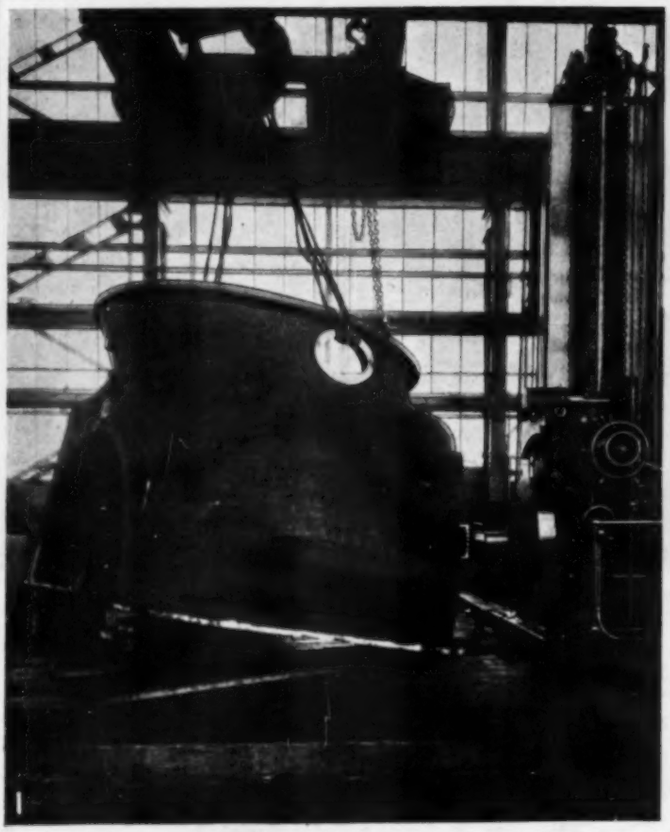


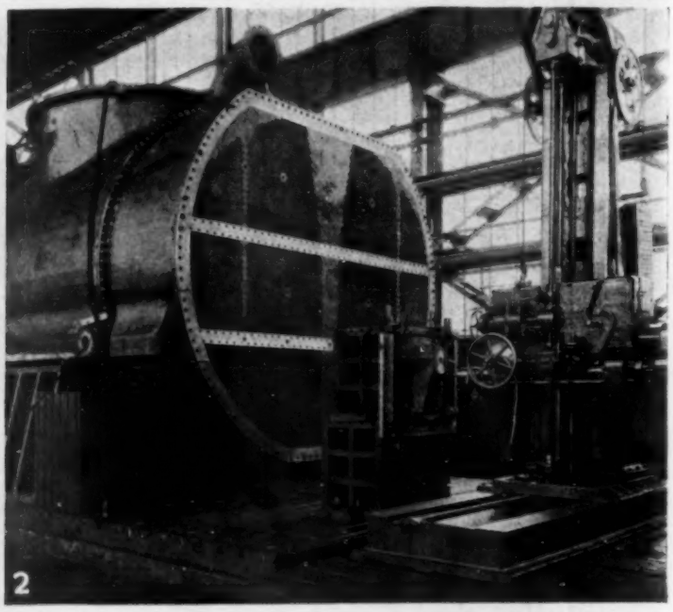


Where Machine Tools Are Made

Landis Tool Company
Waynesboro, Pa.

Established 1897





How Ford Is Building

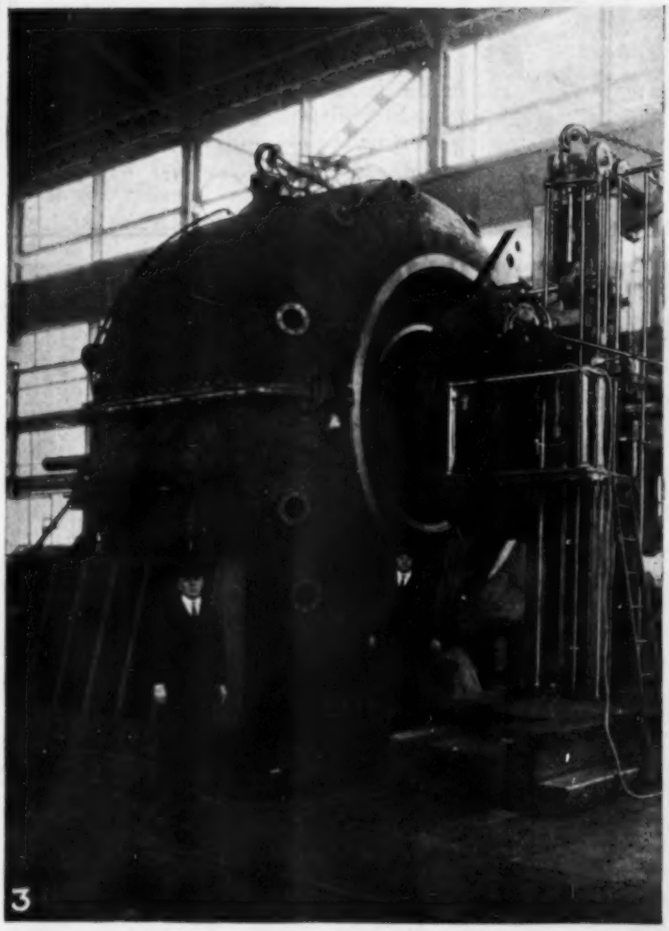
Machining parts for the 62,500 hp. turbo-generator sets

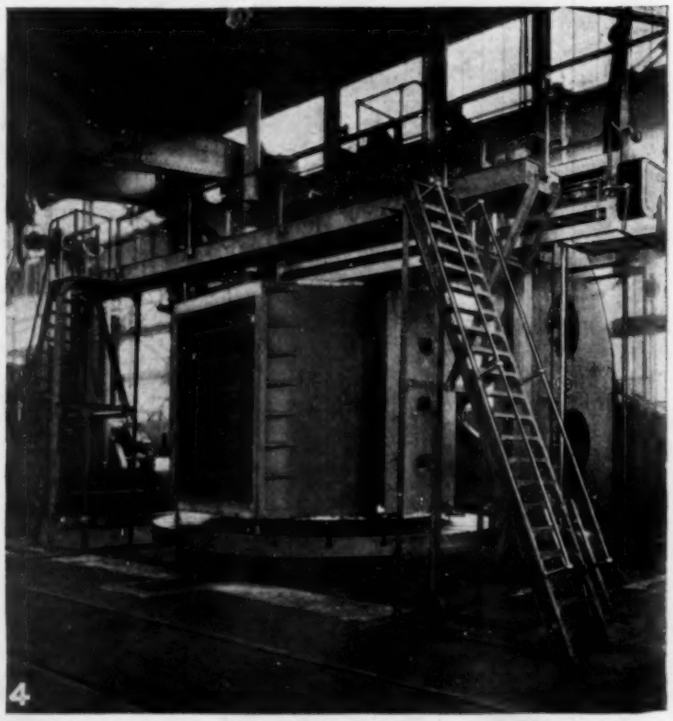
Fig. 1—Milling outlet flange for turbine casing on Niles floor machine

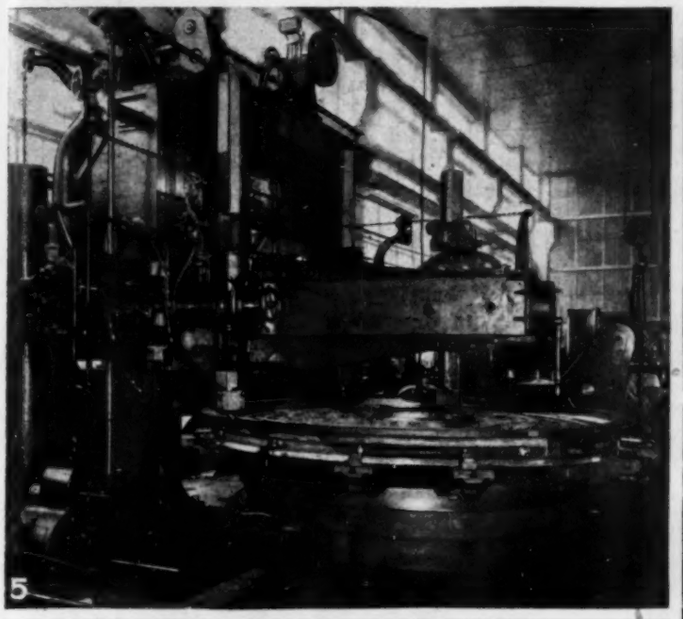
Fig. 2—Boring low pressure turbine casing on same machine

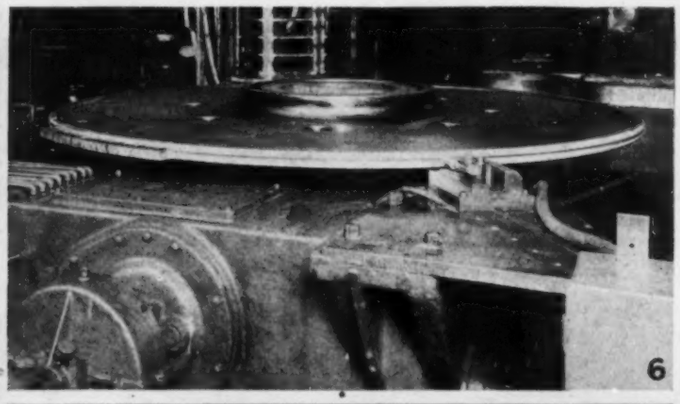
Fig. 3—Condenser in place for drilling for head bolts

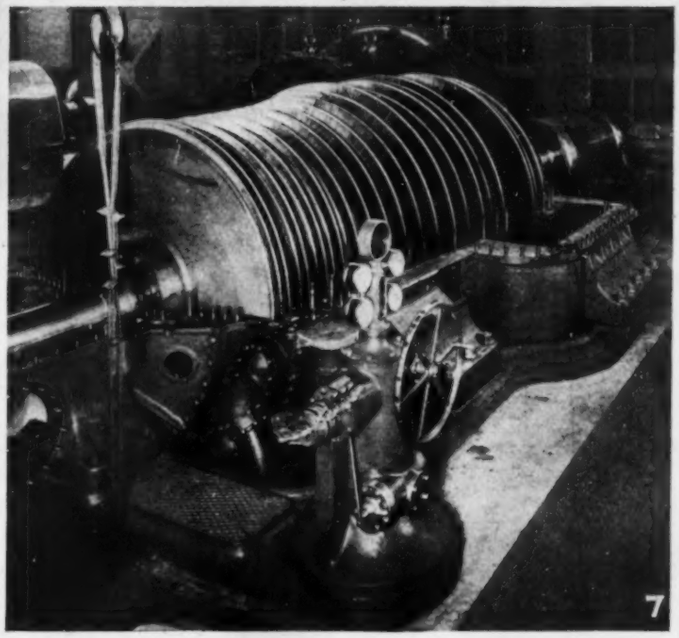
Fig. 4—Facing top of stator housing core on Niles Boring machine











New Power Plant Units

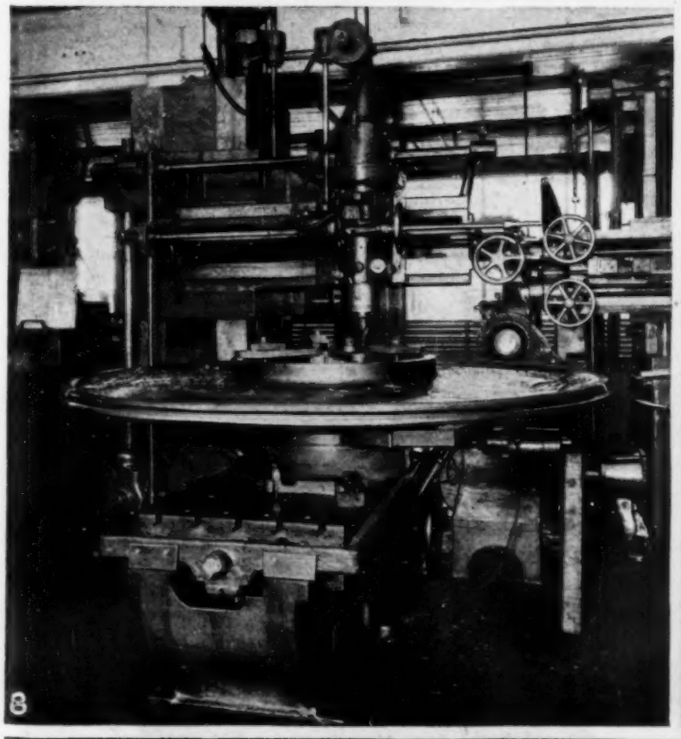
Fig. 5—Turning a turbine diaphragm on a Niles boring mill

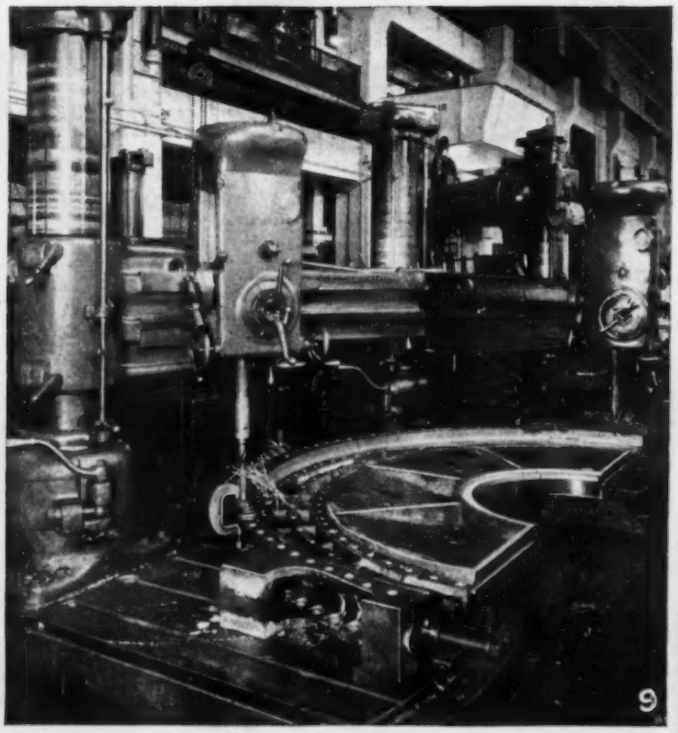
Fig. 6—Blading a turbine disk on specially built machine

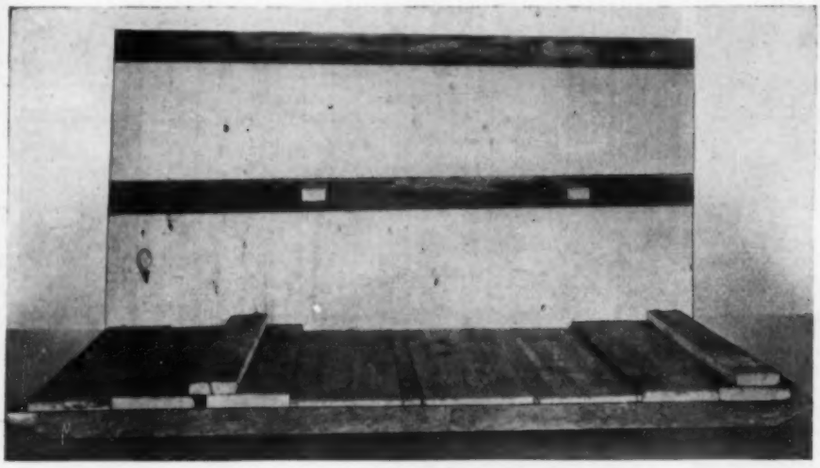
Fig. 7—A 62,500 hp. turbine and generator partly assembled

Fig. 8—Drilling a turbine disk on Ingersoll machine

Fig. 9—Drilling diaphragm with two American radials—using templet

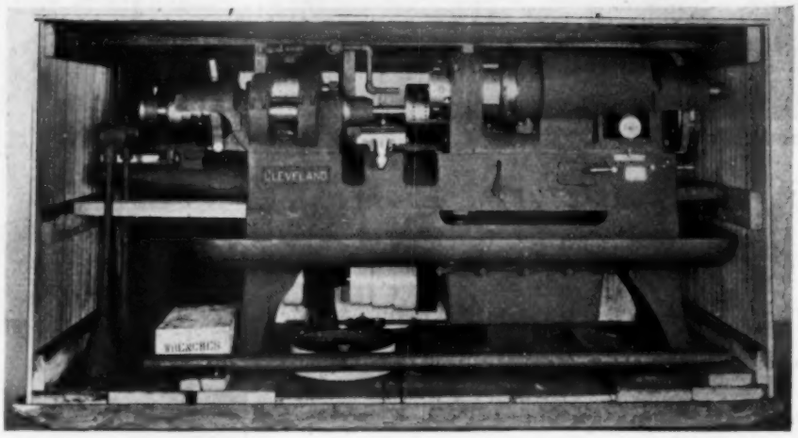






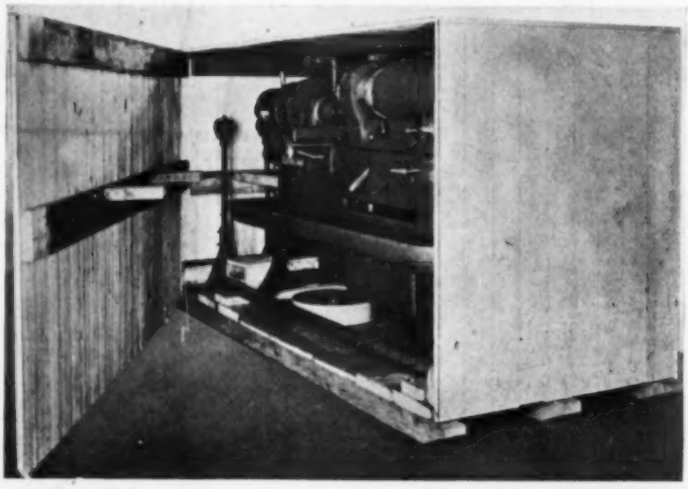
Skid and rear section of box. Three 6x6-in. timbers allow box to be moved on rollers. Upper 2x12-in. plank lag-screwed to skid timbers prevents shifting of machine if leg fastenings give way.

Machine and parts in place. The 2x6-in. timbers that encircle the case at top and bottom and in the middle, prevent crushing when a rope sling is used on shipboard



Insuring Safe Delivery of Cleveland Automatics

Front section ready to be put on. Match board sheathing and tar paper lining to keep out water



The finished crate as used for domestic shipments

Development of Machine Tools in New England

By Guy Hubbard

The sixteenth article—Apprentices and workmen of the Robbins & Lawrence Company—Invention of the automatic screw machine—Improvements in drop hammers

ONE of the Robbins & Lawrence workmen, George Albert Fairfield, whose portrait is shown in Fig. 109, was born in 1834, at Lansingburg, N. Y. He was brought up from the age of four on a hill farm in western Massachusetts, and after attending district school until he was seventeen, George Fairfield entered the shop of Lucius and Ira Dimock at Northampton, Mass., where he learned the machinists' trade. After his apprenticeship he worked for a time as a journeyman machinist at the Holyoke Machine Shop. Then he saw something of the world by working in various shops in Ohio and Virginia. While with Wilcox & Gwyne, Urbana, Ohio, young Fairfield had the distinction of constructing the first power metal-planer built west of the Alleghenies.

Mr. Fairfield went to Windsor at the time the Enfield rifle contract was taken by the Robbins & Lawrence Co. and there, as assistant to Frederick W. Howe and Henry D. Stone, he played a prominent part in the design and construction of the special machinery, jigs, and fixtures used in the execution of the English contract. While there he learned mechanical drawing under Henry D. Stone, and had his first broad experience in the interchangeable system of manufacture. It was there also that he became acquainted with his future associate, Charles E. Billings, who was then completing his apprenticeship at the Windsor shop.

For the author's forthcoming book. All rights reserved.

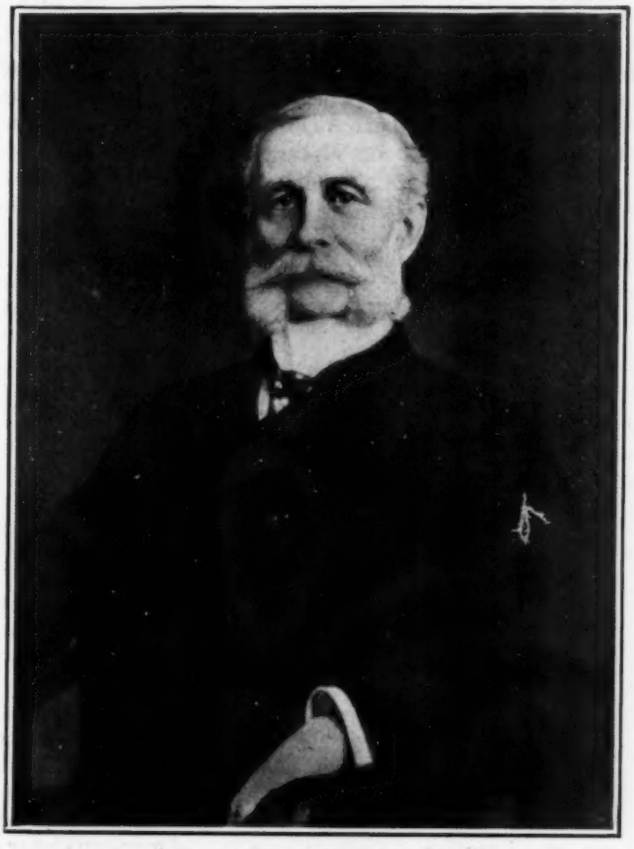


Fig. 109—George A. Fairfield

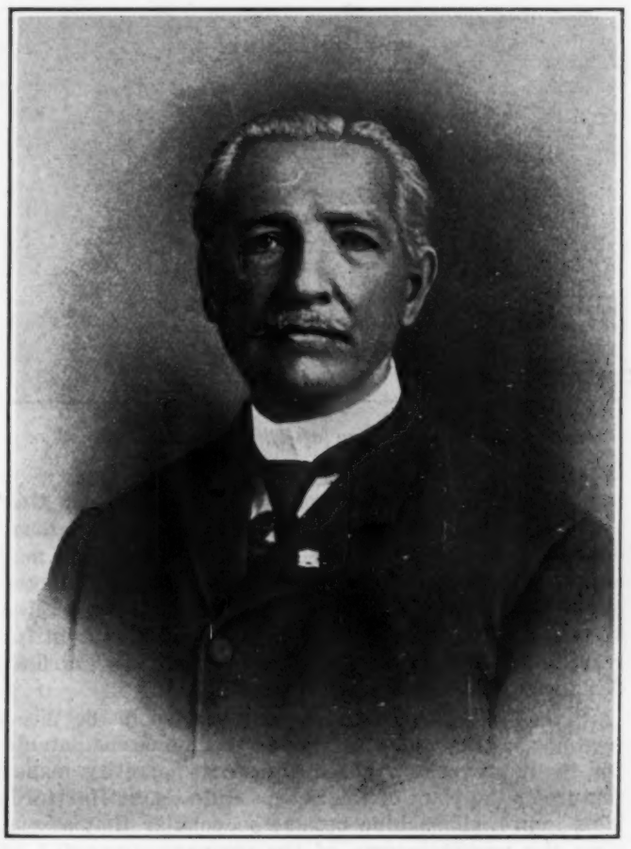


Fig. 110—Charles E. Billings

Upon the failure of the Robbins & Lawrence Co. in 1856, Mr. Fairfield immediately made use of the knowledge acquired at Windsor by becoming the designer of special gun machinery, which the American Machine Works of Springfield, Mass., had contracted to build for the Springfield and Harper's Ferry armories.

In 1857, Mr. Fairfield became a contractor on machinery at the Colt armory, where his Windsor friend, Charles E. Billings, was then also employed. There both Mr. Fairfield and Mr. Billings became acquainted with Christopher M. Spencer, who was destined to play an important part in their future work. Besides becoming the largest machinery contractor at Colt's, Mr. Fairfield opened the first purely mechanical draw-

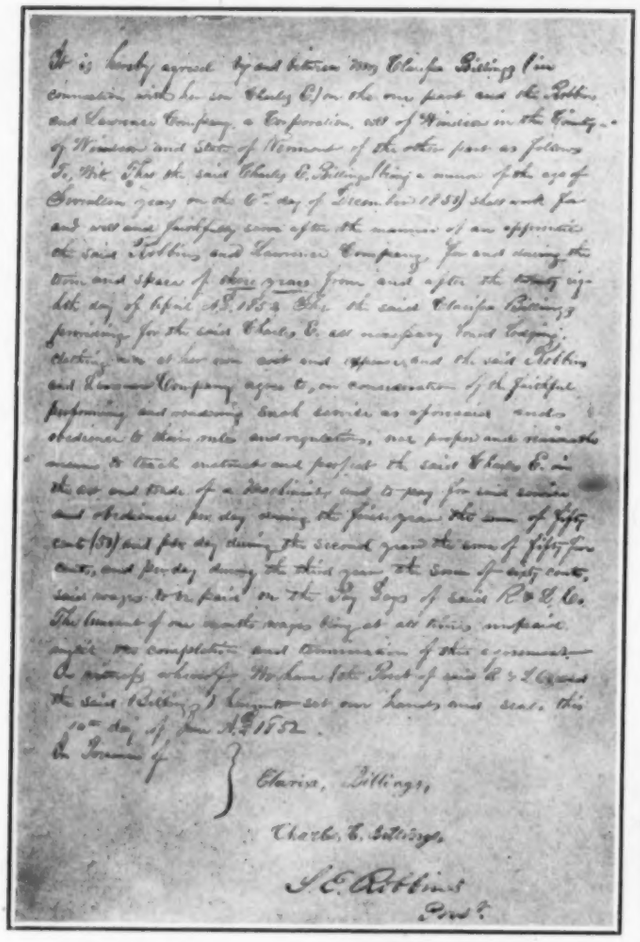


Fig. 111—Indenture of Charles E. Billings

ing school at Hartford in 1858. Under him at this school, some of Connecticut's most notable mechanical engineers of a later period learned drafting and machine design. Mr. Fairfield remained at Colt's throughout the civil war, and upon the close of the war he invested his money in the development of the beautiful residential tract in Hartford now known as Fairfield Avenue.

In 1865, Mr. Fairfield became interested in the Weed sewing machine, and after taking out numerous patents for its improvement, he organized its quantity manufacture at the plant of the Sharps Rifle Co. at Hartford. This improved machine became so popular that at one time the yearly income of the company amounted to $1,200,000. Mr. Fairfield was president of the Weed Sewing Machine Co. from 1876 until 1881. Charles E. Billings was associated with Mr. Fairfield in the early days of this sewing machine business. When Christopher M. Spencer invented the automatic screw machine in 1873, he interested Mr. Fairfield in that epoch making invention, and a department in the Weed sewing machine plant was assigned to Mr. Spencer as an experimental shop for developing his newly invented automatic screw machine. It was there that the original "Spencer" or "Hartford" automatics, from which have directly developed the entire automatic screw machine industry, were first put in operation, and from this experimental department in the Weed plant, developed the Hartford Machine Screw Co. (now part of the Standard Screw Co.), which was founded by Mr. Fairfield and Mr. Spencer in 1876. The automatic screw machine was destined to have a great effect upon the later Windsor industries.

Fig. 112—"Charlie" Billings and "Sam" Porter showing bench lathe and tools built by themselves
(From a Daguerreotype)

Mr. Fairfield was also responsible for the founding of the Pope Manufacturing Co. at Hartford. When the sewing machine business began to fall off, about 1880, he influenced Col. Albert A. Pope of Boston to establish his new bicycle industry at the Weed plant, and it was there that the Pope and Columbia bicycles, the Pope motorcycles and the Pope - Hartford automobiles were later built. In his later years, Mr. Fairfield retired from manufacturing and gave his time to financial and civic work. At the time of his death, in 1908, he was one of the wealthiest and most prominent citizens of Hartford. This Robbins & Lawrence workman represented American interests at the Vienna Exposition

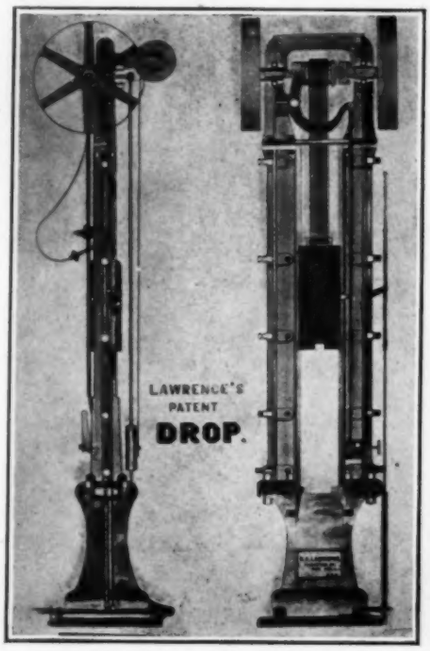
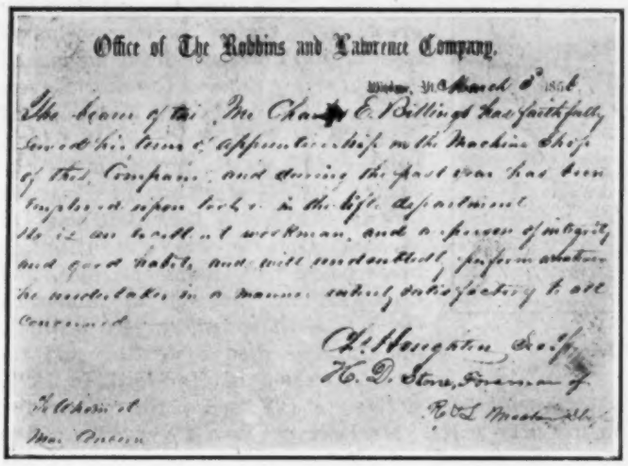


Fig. 113—The Lawrence drop hammer (1853)
(From the original drawing)

of 1873, and had the honor to be decorated by Emperor Francis Joseph for his work in that connection

One of the most representative and picturesque of the Windsor mechanics was Charles E. Billings, a native product and a Robbins & Lawrence apprentice.


Office of The Robbins and Lawrence Company.

Windsor, Vt. March 8th 1856

The bearer of this Mr. Charles E. Billings has faithfully served his term of apprenticeship in the Machine Shop of this Company and during the last year has been employed upon tools in the Rifle department He is an excellent workman, and a person of integrity and good habits, and will undoubtedly perform whatever he undertakes in a manner entirely satisfactory to all concerned

C. S. Houghton Supt.
H. D. Stone, Foreman of
Machine
Mr. Parsons
R. & L. Machine Shop

Fig. 114—"Charlie" Billings' diploma

Charles Ethan Billings, Fig. 110, was born on a farm in the rugged hills of Weathersfield, Vt., some six miles from Windsor Village, in 1835. His father, Ethan F. Billings, a blacksmith, soon after moved to Windsor where he set up a blacksmith shop, and was from time to time in the employment of N. Kendall & Co., making gun forgings. It was under his father that Charles first became acquainted with the primitive art of forging, to the high development of which he was to give his life's work.

Charles Billings attended the common schools of Windsor until the death of his father made it necessary for him to go to work, and he made his real start in life on June 11, 1852, when at the age of seventeen, he was "bound out" by his mother to the Robbins & Lawrence Co. as an apprentice for three years. His indenture paper is reproduced in Fig. 111. About this time another boy was bound out to this company and he and Charles Billings worked side by side and became firm

Fig. 115—Colt's armory in the early days

friends. This boy was Samuel W. Porter, see Fig. 112, later of international fame as a rifle marksman, and for many years the superintendent of the Springfield armory.

Young Billings' work was under Frederick W. Howe, a man for whom Mr. Billings always had the highest respect, and he did much work upon the machinery built for the Enfield armory, which gave him varied and valuable experience. One of his duties as an apprentice was to help in the die forging of gun parts. Early in his apprenticeship this work was done by keying the lower die in a heavy cast-iron "sow block" while the upper die was fastened in a stock called a "jumper," which guided it over the lower die. The dies were cut, or "sunk," in steel blocks to the form of the forging, just as at present, but the power was applied to the jumper by heavy hand sledges wielded by the smith and his helpers. The proper amount of steel for the blank was cut off with the help of a "water gage," the end of the bar being immersed in this device until the water rose to a known point in the tank, and the bar was then marked at the surface of the water for cutting off.

In 1853, Richard S. Lawrence designed and put into operation at Windsor the first "drop hammer" of which Mr. Billings had any knowledge. See Fig. 113. It consisted of a cast-iron base holding the lower die and

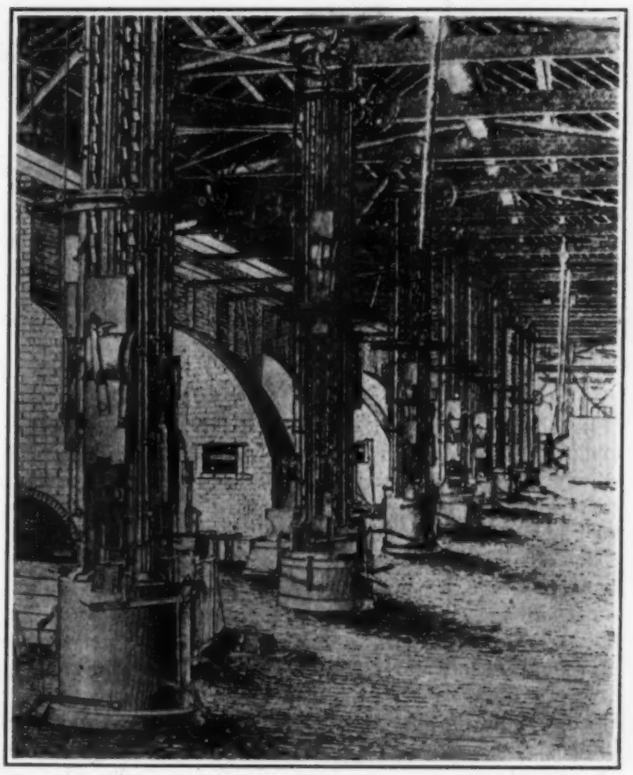


Fig. 116—Root drop hammers in Colt's armory

having two tall uprights to guide the drop in which the upper die was held. At the top of the frame was a horizontal shaft upon which was mounted a pair of drive pulleys and a toothed clutch, while free upon the shaft was a spool with a clutch at one end and a shifting mechanism at the other. This spool raised the drop by winding up a leather belt when the clutch was thrown in. When the drop reached the proper height, a dog threw out the clutch automatically and the hammer was held up by a hook lever until the operator pressed the pedal and unlatched it, the belt rapidly unwinding as the hammer fell freely—unless a careless workman happened to let the clutch in again too soon.

During his last year at the Robbins & Lawrence Co., Mr. Billings learned the art of die sinking, and, at the conclusion of his appenticeship in June, 1856, he re-

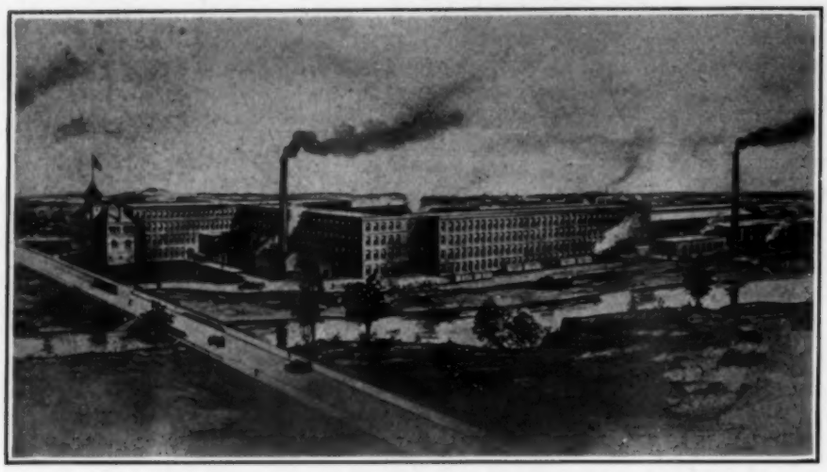


Fig. 117—Plant of The Billings & Spencer Company

ceived his "diploma," which is illustrated in Fig. 114. On the strength of this he obtained a position as die sinker at Colt's armory, Fig. 115, where he became acquainted with the complicated "four drop" screw operated hammers shown in Fig. 116, designed by Elisha K. Root, the mechanical superintendent of Colt's. Mr. Billings worked under Mr. Root at Colt's for six years as die sinker and tool maker, and during that time he became acquainted with his future partner, Christopher M. Spencer, then working at Colt's, and who in his spare time was at work upon the Spencer repeating rifle, which was destined to be such a powerful factor in favor of the North during the civil war.

Forgings for Remington Pistols

In the spring of 1862, Mr. Billings left the Colt armory and closed a contract with E. Remington & Son for the manufacture of 25,000 sets of forged frames for Union cavalry revolvers. Before the war was over, he had forged 280,000 of these frames at his plant at Utica, N. Y., by a new method which saved a pound of imported iron, formerly punched out of each frame—representing a saving of over $50,000 on the entire lot. Messrs. Golding and Cheney, assisted by Christopher M. Spencer, had early in the war designed the "board drop hammer" at the Spencer Repeating Arms Co. at Boston, and these hammers Mr. Billings adopted and improver for his work. Night and day shifts were run in his forging plant at Utica until the "copperheads" of the neighborhood obtained a court order to stop the drops at night. A telegram from Abraham Lincoln immediately set them going again.

From 1865 until 1868, Mr. Billings was associated with his old Robbins & Lawrence shopmate, George A. Fairfield, as superintendent of the Weed Sewing Machine Co. at Hartford. Meanwhile, in 1866, his friend Christopher M. Spencer, in association with Sylvester Roper had invented the Spencer-Roper "Paddle Wheel" repeating rifle and shotgun and had founded the Roper Repeating Arms Co. at Amherst, Mass. for its manufacture. This ingenious gun was not a great practical success, but for its manufacture there was laid out an excellent drop forging plant, in which improved methods were developed by Mr. Spencer. In 1868, Mr. Billings and Mr. Spencer together purchased this equipment and moved it to Hartford, where in the summer of 1869 they established it on Lawrence Street, under the name of the Roper Sporting Arms Co. They soon gave up the manufacture of the Spencer-Roper gun and concertrated upon the development of the art of commercial drop forging, incorporating in 1872 as The Billings & Spencer Co. This pioneer company in the drop forging field has grown to be one of the largest industries of Hartford, and its name is well and favorably known the world over. It now occupies the fine buildings at the edge of Pope Park, in Hartford, see Fig. 117, which were formerly the electric vehicle plant of the Pope interests, and has a Canadian plant in Welland, Ontario, where it manufactures board drop hammers, dies, and drop forgings, as well as numerous small tools invented by Mr. Billings. Mr. Billings died a wealthy and respected citizen of Hartford, in 1920, after having been actively at the head of the concern for nearly fifty years. Mr. Billings was a life member of the American Society of Mechanical Engineers and served as Vice President and President, respectively, of that society from 1893 to 1895.

The Age of Specialization

By James Hartness
President, American Engineering Council

We are all well aware of the futility of an attempt to instantly reverse the direction of a rapidly moving mass of material, and we are equally aware of the hopelessness of sudden reversal of the public opinion, but history tells us a well planned campaign of education sooner or later brings results, sometimes violent and destructive and at other times constructive and beneficial.

Team work in field and factory, in store and mine, on the railways and in the offices, must be accomplished in fact and not in form if America is to make the best use of its energies and resources and to realize the national destiny so eloquently foreshadowed by the precursors of our generation in New England.

On of the factors that forces the team work principle to the front is the need of specialization. The fact that the "Jack of all trades is a master of none" has been recognized by all for many generations, but it is one thing to recognize a fact and it is quite another matter to let it control our action. Great successes have in a large degree been due to the specialized employment of men's energies.

Specialization, though maligned by reformers as a degenerating process, is here to stay. If this nation is to continue to lead, we must make our scheme of life fit this inevitable process of specialization.

Just as some of us were slow to catch the idea that we must declare war against the Central Powers, so do we lag in recognizing the existence of disruptive forces. Conservatism is good so far as it makes for stability, but we must not think our ship of state can be sailed under the old method of control.

Opportunity to lead lies ahead and the engineers should embrace it. In common with all other professions the engineer, departing from his narrow technical sphere, must contribute his knowledge and experience unselfishly for the public good.

An excerpt from a speech delivered to the Hartford Section, A.S.M.E.

Methods of Machine Tool Design

By A. L. De Leeuw
Consulting Editor, *American Machinist*

Differential gearing finds its principal machine tool application in feed mechanism—As applied to hobbing machines—Differential indexing mechanisms

DIFFERENTIAL gearing, though applicable to machine drives, is not much used for that purpose. We find its principal application in feed mechanisms. Perhaps the best known instance of differential gearing applied to machine tools is found in the automatic screw machine in which this system of gearing is used to change over from slow feed to rapid traverse. There is nothing in its application which calls for special analysis and all that is needed to be known can be found in any book which deals with epicycloidal gearing. Another application which is not so well known but which has been used for many years is found in the feed works of some cylinder boring machines in which a pinion at the end of the feed screw travels around another pinion which, in its turn, is revolved by some mechanism containing change gears.

In such machines the feed screw is laid in a slot in the large boring bar, so that the center of the screw is parallel with, but quite some distance removed from, the axis of the bar. All that is necessary, then, is to place a pinion centrally with the axis of the bar and have the gear on the screw mesh with that pinion. The variations in speed of the central pinion not only cause variations in the speed of the screw but will also reverse its motions. In other words, according to the ratio in the change gears, the rotation of the screw may be right handed or left handed or, as it would appear in the calculations, positive or negative.

A device of general applicability is the so-called "jack-in-the-box." This contrivance is made up of four bevel gears, two of which are running loose on a shaft while the other two are mounted on the trunnions of a piece which is keyed to the shaft. Figure 205 shows this device in its simplest form. If gears *A* and *B* should both be turned in the direction of arrow No. 1, the trunnion piece would have to follow at the same speed. In other words, we would have the same conditions as if gears *A* and *B* were keyed to the shaft. The trunnion piece *F* with its gears *D* and *E* serve simply as a means of connecting *A* and *B* to the shaft.

If *B* were held stationary, *A* would cause *F* to revolve at half its own speed. In Fig. 206 the principle of this device is shown by replacing gear *D* by a lever. The two ends, *P* and *Q*, of this lever are gripped in slots of the parts *X* and *Y*. *Y* is stationary but *X* moves in the direction of the arrow. This will give the center *O* a movement in the same direction but, as the two lever arms have the same length, it will travel only half as far as *X*. If *Y* had traveled at the same time, the distance traveled by the center *O* would have been half the sum of the distances traveled by *X* and *Y*.

We see, then, that so long as *A* and *B* in Fig. 205 travel in the direction of arrow No. 1—or, generally speaking, so long as they travel in the same direction—the number of revolutions made by *F* will be half the sum of the number of revolutions made by *A* and *B*. If *A* had traveled in the direction of arrow No. 2 and *B* in that of No. 1, *F* would have had a speed equal to half the difference of the speeds of *A* and *B*, and its direction would depend on whether *A* or *B* has the higher speed.

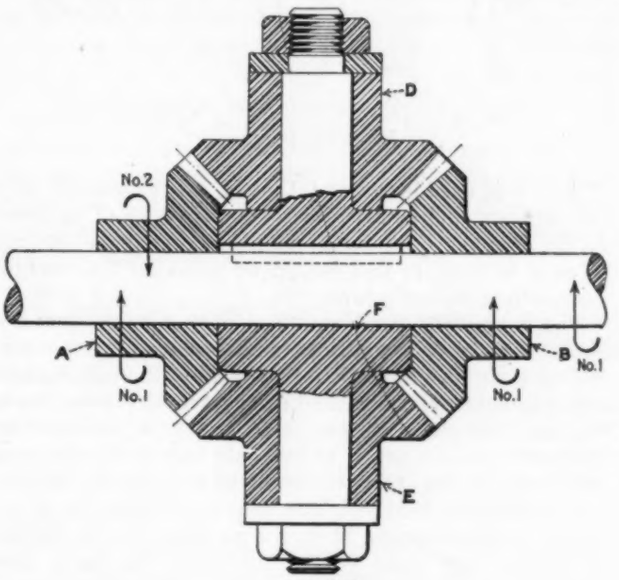


FIG. 205

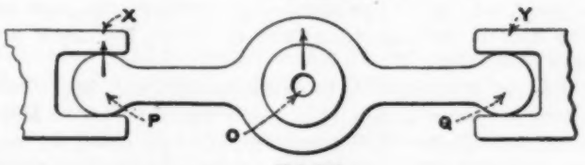


FIG. 206

Fig. 205—Simple form of differential gear. Fig. 206—Diagram to show differential gear action

If *A* and *B* should travel at equal speeds, but in opposite directions, *F* would stand still.

To sum up, we find the following:

Speed of $A = N$; speed of $B =$ zero; speed of $F = \frac{1}{2}N$.
Speed of $B = n$; speed of $A =$ zero; speed of $F = \frac{1}{2}n$.
In either case, direction of *F* is the direction of the running gear.

Speed of $A = N$; speed of $B = n$; speed of $F = \frac{1}{2}(N + n)$, if *A* and *B* run in the same direction.

Speed of $F = \frac{1}{2}(N - n)$, if gears run in opposite direction. In all cases, direction of *F* is the direction

of fastest running gear. If *A* and *B* travel at equal speeds and in the same direction, the effect is the same as if they were keyed to the shaft. If *A* and *B* run in opposite direction and at equal speeds, member *F* stands still.

We see, then, that in some cases the "jack-in-the-box" can be made to add the effect of two systems of gearing and that, in other cases, it can be made to subtract the effect of the one from that of the other. As a matter

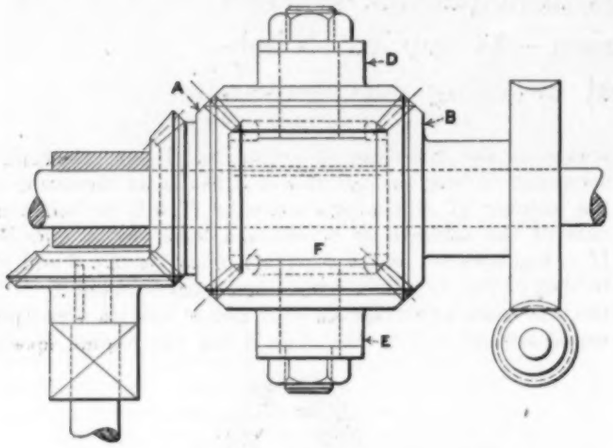


Fig. 207—Differential gear as applied to hobbing machine

of fact, it is used both ways, that is, it is sometimes used for addition and sometimes for subtraction of motions. As an example of how the addition of movements can be used in machine tool design we will take the machine for hobbing helical gears.

The gear itself must rotate at such a speed that the hob will make *N* revolutions per revolution of the gear if this gear has *N* teeth. In addition, it must make a small amount of movement in the same direction, due to the fact that the teeth are at an angle. If the hobbing machine were arranged to cut only one particular gear and nothing else, then it would be possible to arrange the machine so that hob and gear travel exactly at the proper relative speeds. If such a machine is to be capable of cutting any gear within its range, we must have means to take care of whatever variations in speed may be required due to the number of teeth of the gear and also due to the various angles at which the teeth may have to be cut.

Though it is possible to calculate the exact speed ratio between gear and hob, this is not an easy matter and it would be simpler if the two adjustments could be made separately, that is, if we should have a gear changing device which would take care of the variable number of teeth, and another one to take care of the variable angle of spiral. If this should be done, it would be necessary to add these two movements and our jack-in-the-box would be the means to make this addition. We might have a device somewhat like the one shown in Fig. 207, in which *A* and *B* are again the two bevel gears driving the two gears *D* and *E* located on the trunnion piece *F*. Gear *A* is driven by a bevel gear, keyed to a shaft which gets its motion from the change gear system which takes care of the number of teeth. Gear *B* is provided with a worm wheel driven by a worm which gets its motion from a change gear system which takes care of the spiral angle.

An interesting example of the use of the jack-in-the-box for the purpose of addition of movement was illustrated a number of years ago in the *American Machinist* in an article describing a punching machine with automatic spacing table. The holes to be spaced were sometimes several inches apart and the dimensions were given in eighths of an inch. If the spacing device had translated every dimension in eights, a great range in this device would have been necessary. For instance, there might have been at one time a spacing of $\frac{3}{4}$ in., at another time of $7\frac{1}{8}$ in., which, translated into eighths, would mean that the first time a movement of 12 and the second time a movement of 57 was required.

Simplified Spacing Mechanism

In order to overcome this difficulty of having such a great range in a single device, the spacing mechanism was operated from two sources. One source provided the necessary means for spacing by inches. A movement of 2, or 3, or 7 inches could be made by this part of the device, but no fractions. The second source provided means for spacing by one-eighth of an inch up to one inch. It was capable, then, of spacing $\frac{1}{8}$, or $\frac{1}{4}$, or $\frac{7}{8}$ in., but no more. These two sources of movement delivered their effect to the two sides of a jack-in-the-box. In this manner two simple devices took the place of one very cumbersome arrangement.

Many cases will present themselves in which the jack-in-the-box can be used for the addition of movements. One more interesting example of its use will be quoted here, and that is its application to dividing mechanisms. The principle of this device is illustrated in Fig. 208. *A* is a shaft which drives the dividing mechanism, let us say, a wormwheel mounted on a spindle. The shaft *A* is moved by means of gear *B* and the jack-in-the-box, so that one revolution of *B* will move *A* one-half revolution. Let us suppose that one revolution of *B* causes the wormwheel to travel through one-sixtieth of a revolution; in other words, let us suppose that the entire device is set for dividing into sixty equal parts (if there

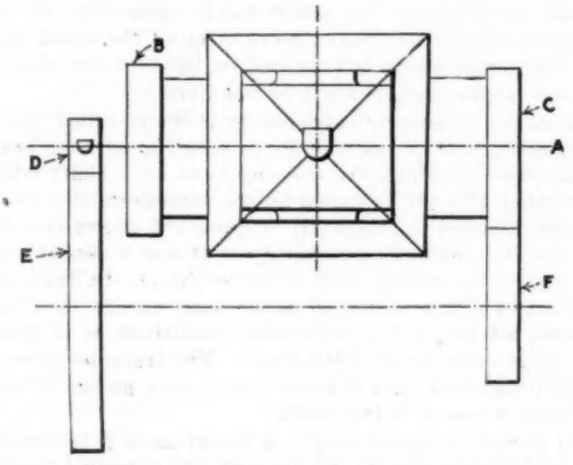


Fig. 208—Diagram of dividing mechanism

were no other mechanism except that described just now).

So far we have supposed gear *C* to be stationary. We will now see what the effect would be if the gear *C* were also moved. If we should move this gear *C* in the same manner as we have moved the gear *B*, that is, from some outside source, we would merely have to add the two movements. For instance, if we give gear *C* one-third of a turn every time the gear *B* moves a whole

turn, then the result of the two movements would be that we would not get one-sixtieth of a turn of the worm-wheel but one-sixtieth plus one-third of one-sixtieth, which would make one-forty-fifth.

The arrangement as shown in the illustration is, however, of a different nature. The gear *C* is not driven from some outside source but from the shaft *A* itself through gears *D*, *E* and *F*. Let us suppose that these three gears are all equal and of the same size as *C*.

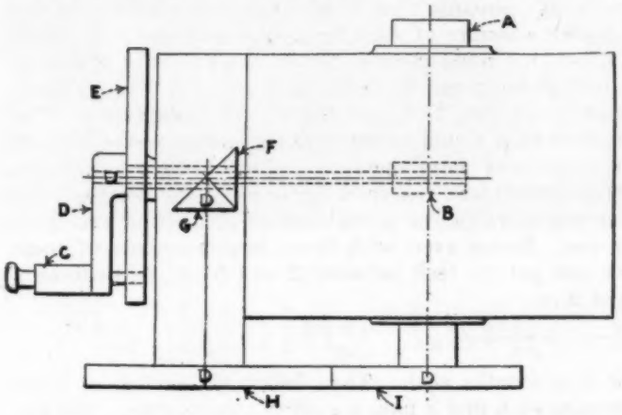


Fig. 209—Differential indexing mechanism

Then one revolution of *A* will cause one revolution of *C* and in the same direction. In order to understand the action of this device somewhat better, we will apply the well-known law of mechanics that the result of two movements taking place at the same time is the same as if the body had first been subject to one movement and then to the other.

Applying this principle, we will first turn *B* one complete revolution, holding gear *C* stationary. This will cause shaft *A* to revolve one-half revolution and this causes the index wheel to make one-sixtieth of a revolution. We will now hold gear *B* stationary and, imagining that the gear *D* was not attached to the shaft, we will give this gear the amount of movement which it would have had if it had been attached to the shaft in the first place; that is, we will turn it through one-sixtieth of a revolution. This will cause gear *C* also to move through one-sixtieth of a revolution, and as this gear turns in the same direction as gear *B*, we can add the movements given to the shaft by the gears *B* and *C* individually.

Total Movement of Index Wheel

The amount, then, we have to add to the movement of this shaft is 1/60 x 1/60 of a revolution of the index wheel. This little amount of movement causes again the gear *D* to move and therefore adds somewhat again to the movement of the shaft, this time 1/60 x 1/60 x 1/60 and so on. The total amount of movement of the index wheel, then, will be the sum of the terms of an infinite geometric series:

$$1/60 + (1/60)^2 + (1/60)^3 + (1/60)^4 +, \text{ etc.},$$

which is equal to 1/59.

If we had placed an idler between *D* and *E* or between *F* and *C*, the result would have been that any movement of the shaft *A* makes the gear *C* move in the opposite direction, so that here we would have a subtraction, and our series then would become:

$$1/60 - (1/60)^2 + (1/60)^3 - (1/60)^4 +, \text{ etc.},$$

which is equal to 1/61.

We see, then, that if such a mechanism were introduced in a dividing engine, it would be possible to make correct divisions without having either a dividing plate or a change gear with the same number of divisions or with a multiple thereof. This method of indexing, now known as the differential system of indexing, was first described by the author in the *American Machinist* in 1901, and has been applied to the dividing head of milling machines in a somewhat different form, though based on the same principle.

The mechanism for this system of indexing is illustrated in diagram 209, in which *A* is the spindle of a dividing head, *B* is the worm which drives the worm-wheel and which is taken along by handle *C* of lever *D*. In plain indexing one revolution of this handle would cause the spindle to revolve through 1/40 of a revolution. The plate *E* is ordinarily held stationary. If there should be a circle of 60 holes on this plate and we should move the handle 40 holes, we would have caused the spindle to revolve through 40/60 x 1/40 of a revolution, which is 1/60 of a revolution. When differential indexing is employed the plate *E* is not held stationary. On a sleeve of this plate a mitre gear *F* is mounted which which is moved by means of its mating gear *G*, the gear *H* which is keyed to the shaft of *G*, and the gear *I* which is fastened to the spindle in some way; for instance, by mounting it on a taper stud and driving this stud in the taper hole at the back end of the spindle. If the gears *H* and *I* are equal, then 1/60 of a turn of the spindle will move the plate *E* through 1/60 of a turn. The movement of the plate would take the handle along the same amount, which would cause the spindle to move some more, and this in its turn would cause the plate to move somewhat further, etc.; so that the final result would be that the handle has moved

$$\frac{40}{60} + \frac{1}{60} \times \frac{40}{60} + \left(\frac{1}{60}\right)^2 \times \frac{40}{60} + \left(\frac{1}{60}\right)^3 \times \frac{40}{60} + \ldots\ldots \text{etc.}$$

As a result, the spindle would have moved 1/40 of this amount because there are 40 teeth in the wormwheel, so that the final amount of movement of the spindle would have been

$$\frac{1}{40} \times 40 + \left\{ \frac{1}{60} + \left(\frac{1}{60}\right)^2 + \left(\frac{1}{60}\right)^3 + \left(\frac{1}{60}\right)^4 + \ldots\ldots \text{etc.} \right.$$

which is 1/59.

If in an infinite geometric series, the first term is a and the ratio is r (this ratio must be less than unity), then the sum of this infinite series is $\frac{a.}{1-r}$ This formula will show what the ratio should be between gears *I* and *H* in order to obtain a division different from the divisions provided by plate *E*.

In considering the possible applications of the jack-in-the-box we will first assume that it is used for feed only, and we will give gear *A* a constant speed and gear *B* a variable speed. Whatever this speed of *B* might be, we notice that we would produce a quick traverse if either *A* or *B* alone were running, while the other side would be held stationary. We further notice that the quick traverse would be in one or the other direction, depending on whether *A* or *B* is running, provided *A* and *B* themselves run in opposite directions.

If *A* and *B* both run, but in opposite directions, we will have a feed of which the direction is determined by that of the fastest running gear. In order to limit further our first consideration, we will divide the cases we may meet into two groups. In the first group we have those cases which we will get when the entire system runs relatively fast; in the other group, when the sys-

tem runs relatively slow. By "fast" and "slow" we mean that it would take a great many revolutions or only a few revolutions of the shaft of the jack-in-the-box to produce 1 in. feed of the system. Let us suppose that *A* runs 200 revolutions, that we use the fast system, and that the shaft of this system will have to make 25 revolutions to cause 1 in. feed. As the speed of this shaft equals half the difference of the speeds of *A* and *B*, we must have a difference between the speeds of these gears of 50 r.p.m. in order to obtain 1 in. feed. We will then get:

for 2 in. feed.....A-B = 100.....B = 100
for 3 in. feed.....A-B = 150.....B = 50
for 4 in. feed.....A-B = 200.....B = zero.

This shows that the extreme range of feeds we can get out of this arrangement is limited to 4 in. as a maximum. On the other hand, we could get an almost unlimited number of feeds below 4 in.

If we should utilize the slow system in which, let us say, the shaft would make 1 revolution for 1 in. feed, we would find that A-B is 2 in. as a minimum, that is, for 1 in. feed, so that *B* would be 198; and for other amounts of feed we would find the following:

for 2 in. feed.....A-B = 4.....B = 196
for 3 in. feed.....A-B = 6.....B = 194
for 4 in. feed.....A-B = 8.....B = 192

Obviously a great many feeds beyond 4 in. per minute are possible with this arrangement. On the other hand, it is also obvious that it is not possible to obtain the smaller amounts of feed by easy gradations. In order to see this more clearly, let us consider the speeds at which *B* must run to obtain 2, 3 and 4 in. feed. These speeds are 196, 194, and 192 r.p.m. respectively. The gears which would produce these speeds would have to be in ratio of these amounts, and would have to have 98, 97, and 96 teeth respectively, because the smallest difference there can be in the number of teeth of the gears is *one*. Hence even with these large numbers of teeth we can get no feed between 2 and 3 in., or between 1 and 2 in.

An Apprentice System that Works

By Francis C. Henry

IN VIEW of the revival of interest in the training of skilled men, the methods that have proved successful in an old and well-known manufacturing plant should be of value. The Weston Electrical Instrument Co., Newark, N. J., has long believed in the necessity, as well as the advisability, of training boys for its tool and die making departments. Incidentally this same training has proved of value in giving young men a good foundation on which to build the necessary qualifications for executive positions. And high grade shop executives are as necesary to the success of a manufacturing plant as are skilled workmen.

The apprenticeship system is under the direct supervision of the tool supervisor, the foreman of the tool department, and an instructor. The applicant must be between 16 and 18 years of age and must have graduated from a grammar school. If accepted, he serves a month at the regular compensation for the first period to discover to the satisfaction of both parties whether he is adapted to the work. If accepted, he receives credit for this month toward his four years of training.

A Gentleman's Agreement

One of the unusual features is that there is no written contract, both parties being governed by a verbal agreement. One of the agreements is that the applicant is to attend night school or take up a correspondence course, covering mathematics, mechanical drawing and the elements of mechanics, together with any other studies he may choose. This is to bring home the fact that a knowledge of mechanics is of prime importance to the thorough mechanic. Reports of progress and samples of the work done in school, must be submitted to the tool supervisor and to the employment manager.

The system is definitely scheduled to include thirteen periods during the four years, as scheduled below. The first two periods are of six months each, the next four of four months each. Then follow six periods of three months each and a final period of two months. The pay starts at 20c. per hour, and increases 2c. per hour, except that the last increase is 4c., making the final payment 46c. per hour, or $22.08 for a 48-hour week.

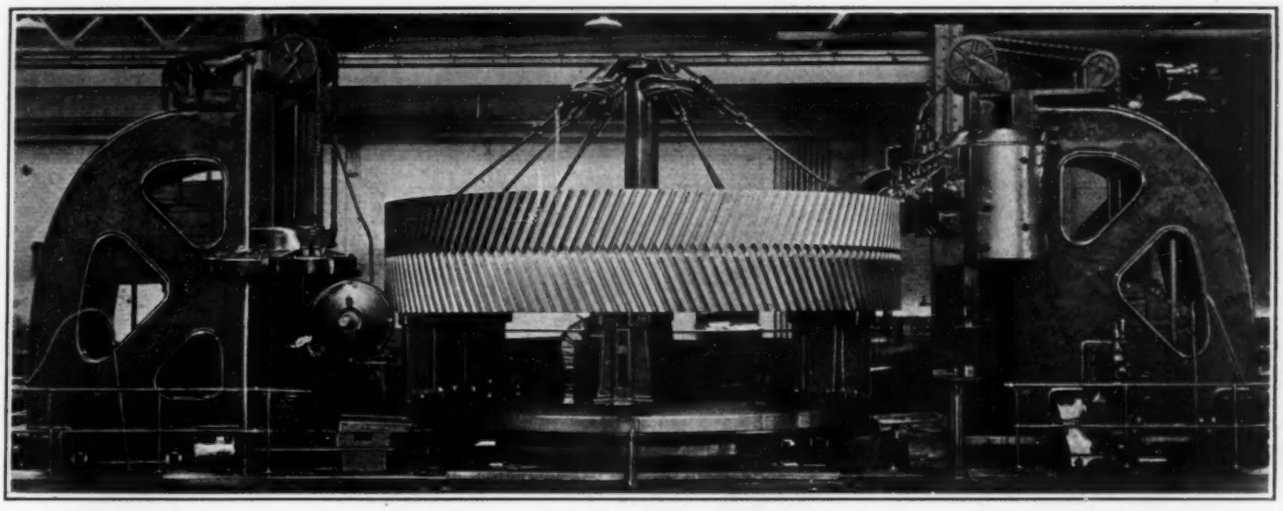
It will be noted that the boy begins with three months in tool storage work, which familiarizes him with the names of tools, the system of keeping track of them and the way in which they are inspected and reconditioned if necessary. Transfers depend, of course, on the fitness of the boy to make the change. The schedule follows:

Department	Time	Period	Hourly Rate
Tool storage	3 mos.		
Drill and planer	2 mos.	1	$0.20
Milling and shaper	1 mo.		
Milling and shaper	2 mos.		
Grinding	4 mos.	2	.22
Grinding	2 mos.		
Universal milling	2 mos.	3	.24
Universal milling	4 mos.	4	.26
Engine lathe	4 mos.	5	.28
Engine lathe	2 mos.		
General machine work	2 mos.	6	.30
General machine work	3 mos.	7	.32
General machine work	3 mos.	8	.34
General machine work	1 mo.		
Tool hardening	2 mos.	9	.36
Bench work or drafting (Optional)	3 mos.	10	.38
Bench work or drafting (Optional)	3 mos.	11	.40
Bench work or drafting (Optional)	3 mos.	12	.42
Bench work or drafting (Optional)	2 mos.	13	.46

The tool-department foreman keeps a record of the boy's work. There is also a written test concerning the work, this being checked and graded by the tool supervisor. Seventy per cent is necessary for promotion.

When an apprentice fails to qualify for promotion, he serves whatever additional time may be necessary. He also makes up any time lost during the apprenticeship period. Boys who do not make good are dismissed to prevent waste of time on both sides. A flagrant violation of rules also carries the same penalty.

On completion of the course, the graduate receives a bonus of $100 and a certificate of apprenticeship. In addition he is given a miniature certificate of card case size, for easy use and reference.



Machining Large Herringbone Gears

By Howard Campbell
Western Editor, *American Machinist*

The manufacture of gears of unusual size for reduction units—Hobbing gears 16 ft. in diameter—Grinding in the teeth and balancing — Hob making and grinding

THE production of large herringbone gears for high-power reduction units, presents a problem that is as interesting as it is unusual. The Falk Corporation, Milwaukee, Wis., has been producing gears of this type for twelve years and the demand for them for use in marine engines, steel, sugar, rubber, cement, and other mills is constantly increasing. A great many of the gears produced by this company are used in marine reduction-units in connection with steam turbines. With gears that transmit, in many cases, several thousand horsepower from the engine to the driving mechanism, an unusually high standard of workmanship is necessary in order that they may work smoothly and without vibration at very high speed.

Equipment for producing work of this class must necessarily be highly specialized, and as the Falk engineers obviously understood their peculiar problems better than could anyone else, a large part of the equipment was built in the Falk shops.

The Machine Shop

The illustration, Fig. 1, is a view of one section of the machine shop where the general machining is done, exclusive of gear cutting, assembling, and hob-making. The gears are cast of open-hearth steel and have extremely large shrink heads and very heavy stock allowances on face and sides, to insure freedom from hard spots and sand. The castings are made in the Falk Corporation's own steel foundry (which is one of the most completely equipped steel foundries in the country) and are then brought into this shop for machining. Gears that are not larger than 6 ft. in diameter are usually cast solid, while those that are larger than 6 ft. are cast in halves, or with a "split hub," to avoid shrinkage strains. When cast in halves the parts are fastened together with heavy bolts in the hubs, rims, and arms.

On a gear that is cast in halves, the first operation after the snagging or rough grinding has been done, is that of planing off the faces where the halves are joined together. The operation is shown in Fig. 2, in process on a Morton draw-cut shaper.

How the Gear Blank Is Turned

The gear is next turned on a Niles-Bement-Pond 16-ft. boring mill, as shown in Fig. 3. The mill is driven by an Allis-Chalmers 75-hp. motor. A 15-hp. motor supplies the power to move the head. The gear shown in process is 16 ft. in diameter with a 40-in. face, and but 0.005 in. limit is allowed in diameter.

The headpiece of this article shows a gear in process of hobbing on what is probably the largest herringbone gear-hobbing machine in the world. The machine occupies a floor space about 43 ft. square, is 16 ft. high, and weighs 150 tons. It will cut gears of all pitches up to $\frac{3}{4}$ diametral pitch, of diameters from 3 ft. 2 in. up to 16 ft. 3 in., and up to 6 ft. face width. The work table is located between two heads, each of which carries a hob, as shown. The hob at one side begins at the lower edge of the gear and cuts upward while the other begins at the upper edge and cuts downward. The heads are mounted on ways so that the proper adjustment can be obtained, a $7\frac{1}{2}$-hp. motor providing power for moving each one.

Power is supplied to the machine through an Allis-Chalmers 30-hp. motor, which, together with the rest of the operating mechanism, occupies a pit at the rear of the machine, as shown in Fig. 4. The main driving

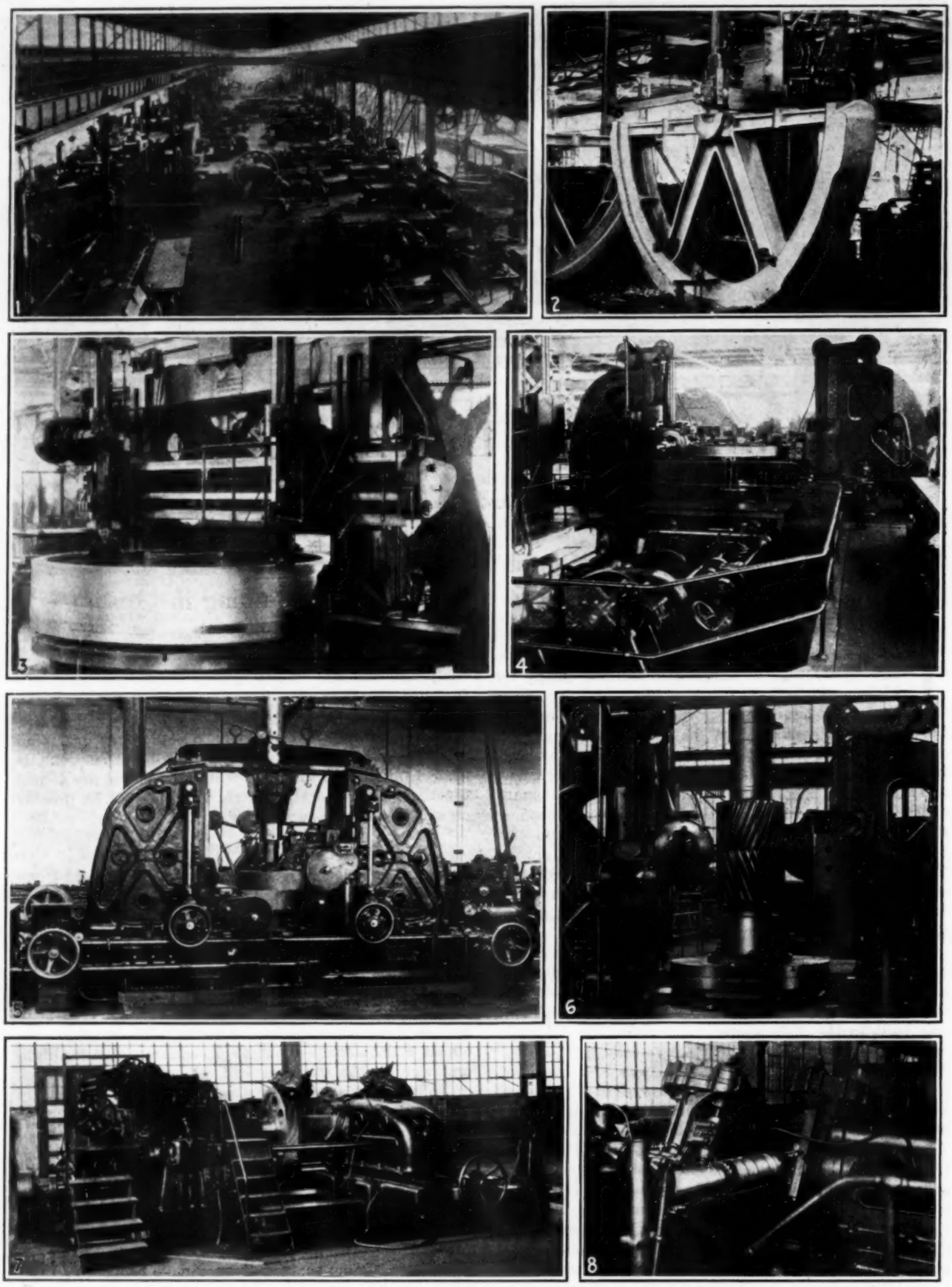
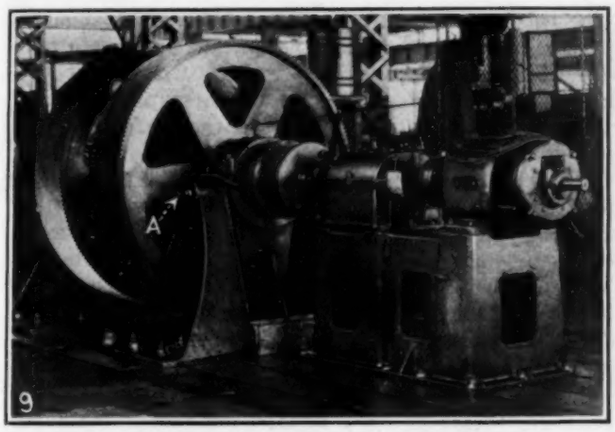
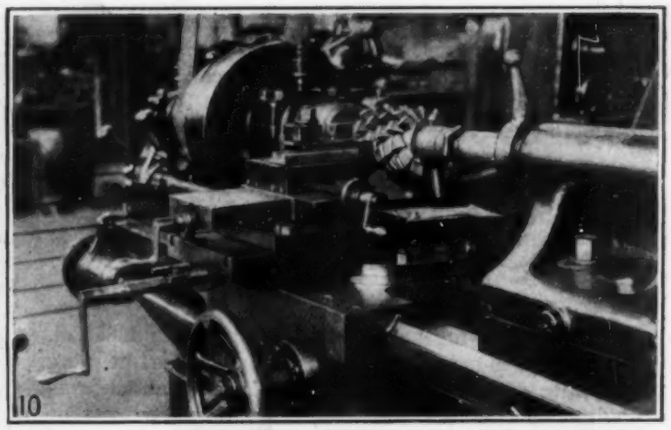
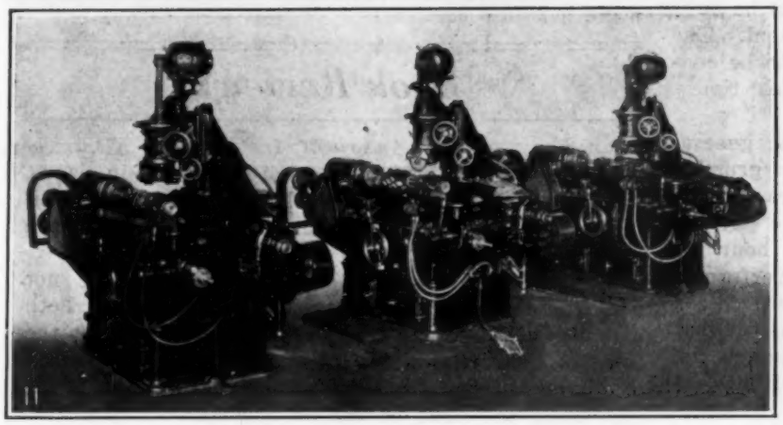


Fig. 1—Section of Falk machine shop. Fig. 2—Planing a gear segment. Fig. 3—Machining the gears. Fig. 4—Driving the operating mechanism. Fig. 5—The gear is cut on its own shaft. Fig. 6—Hobbing a pinion. Fig. 7—A precision hobbing machine. Fig. 8—The hob in operation







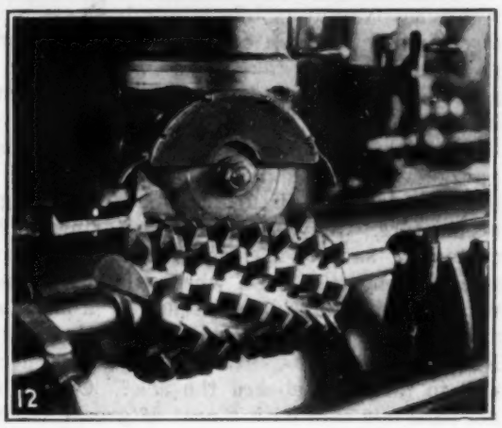


Fig. 9—Balancing a herringbone gear. Fig. 10—A Reinecker-type relieving lathe. Fig. 11—Part of hob grinding department. Fig. 12—Grinding an 8½-in. hob.

unit operates a drive shaft for rotating the table, and also for feeding the cutter heads up and down. Gear boxes allow for variation in the speed of the table and the feed of the cutter heads.

A gear 40 in. in diameter and 24 in. across the face, intended for use in the gear reduction of an industrial drive, is shown in process of cutting in Fig. 5. In order that the pitch circle may be true with the axis, the gear is keyed to its own shaft. The lower end of the shaft is held by setscrews in a pot chuck attached to the table of the machine, and the upper end runs in a bushing in the steadyrest. The set-up for cutting a herringbone pinion is shown in Fig. 6. In this case, the shaft is so large that, with a chuck of sufficient height and strength, the steadyrest is not needed.

An 80-in. machine, so called because it will cut gears up to 80 in. pitch diameter, is illustrated in Fig. 7. This machine also has two heads, each of which will swivel to any angle. The machine is operated by an Allis-Chalmers 20-hp. d.c. motor, the speed of which can be varied from 200 to 800 r.p.m., according to the size of the gear being cut. On the machine shown, precision work of the highest type can be obtained; accordingly it is used only for cutting high-speed gears required for turbine reduction drives, where the pinion runs at a speed of 3,600 r.p.m. or more. For cutting the pinion shown in the illustration, a 2-pitch hob 8-in. in diameter and running at 28 r.p.m. is used. In Fig. 8 the hob can be seen in operation.

After the teeth have been cut, the gears are run in with abrasive and oil, after which they are balanced, using the outfit shown in Fig. 9. The gear shown in process is a low-speed gear for use in a 2,800-hp. marine-turbine reduction drive. In this instance, the gear is made in halves and separated as shown in order to better find the point of unbalance, if any. The gear shaft rests in bearings in supports that are pivoted at the base, but are held on center by means of setscrews similar to the one indicated at *A*. The shaft is coupled to a 50-hp. variable-speed motor. When the gear is running at a sufficiently high speed, the clutch is thrown out and then the screws are slowly withdrawn, and any vibration or "unbalance" noted. The gear is then balanced in the usual manner.

As the hobs used for cutting Falk herringbone gears are so large as to be practically special, they are all made in the Falk plant. The operation of cutting the relief on a hob, using a special or relieving lathe, is shown in Fig. 10. The machine is of the Reinecker type, although built in the Falk plant. In this type of machine the toolrest is moved forward by a cam, the roller being attached to the underside of the toolrest, the cam being integral with a shaft running through the center of the machine parallel with the ways and below the carriage. Two heavy springs keep the roller in contact with the cam. The machine is universal, any number of threads or length of lead being possible. The time required for relieving a hob such as that shown in the machine—2 diametral pitch, 4 threads—is approximately 5 days. The largest hob that has been used up to the present time is 8½ in. outside diameter and ¾ diametral-pitch.

To keep the hobs properly ground, a battery of five hob grinders is required, three of which are illustrated

in Fig. 11. The machines were designed and built by the Falk Corporation. The table speed is 48 in. per minute. The grinding wheel, which can be seen to better advantage in Fig. 12, is a Norton 3850-K, 7 in. in diameter, and runs at 3,500 revolutions per minute.

Machine Tool Equipment and Garage Service

BY RHODES POLLEYS

A very interesting article appeared on page 368, Vol. 60, of the *American Machinist* under the heading "Equipping for Automotive Service." This article was evidently written with the intention of showing that a progressive automobile repair business must be built on a firm foundation of machine tool equipment. The point is very well taken and the author is to be congratulated on bringing up a subject of such timely interest to every motorist.

We have all suffered at the hands of some general garage men, and have paid our bills with a grumble that should have disturbed even the most grasping of proprietors. Why should the motoring public pay the customary seventy-five cents or a dollar per hour for so-called expert service, when as a rule it is performed with the mechanical assistance of a dull-faced file, a slow-speed drill press, and perhaps a welding outfit that Noah would have spurned, had it been necessary for him to take one aboard the ark? On top of this we get back our cars with a coat of grease from the steering wheel to the upholstery.

There are many excellent garages throughout the country and general criticism of the business must of course be understood to apply only where the shoe fits. The motorist has several grievances against the average garage as operated today, and a rehearsal of these sources of ill feeling may help to improve the service. Not only will the service rendered to the public be improved, but the annual income of the garage man should be similarly affected, if the following suggestions are carried out.

CRITICISM OF THE AVERAGE GARAGE

First of all, a big source of annoyance can be traced to the lack of punctuality from which nearly every garage suffers. A car, for example, owned by a doctor is accepted for repairs by the garage man. The car is promised for two o'clock and, when the doctor arrives ready to hustle out to the country for a consultation, he is informed that the car will not be ready until five. The next time he has a repair job, it is practically an assured fact that a different garage will be chosen.

The second fault is carelessness. This is usually found in assembling the mechanical parts after the car has been torn down for repairs. The writer recently had a transmission repair performed on a light model car at a so-called authorized service station. It was necessary to wait an extra hour before the work was completed and then a twenty-mile drive was started. Suddenly a laboring was noticed in the engine, and before any investigation could be made the driver was pitched forward as the car stopped abruptly. Subsequent investigation showed that a careless mechanic had left out a gasket at a critical point, when he had reassembled the parts. Result—one badly scored block with seized pistons and an infuriated motorist.

The third point, and really the most important since it affects our pocketbook, is the lack of up-to-date machine equipment that is so prevalent throughout the general garages. Referring to the first part of this article, the reader can appreciate the unfairness of charging a high hourly rate for garage service performed with hand drills instead of the electric portable kind. Slow and tedious chipping and filing is often paid for, when a hand milling machine or a light shaper would handle the job in half the time. A service station is only entitled to the maximum hourly rate when the job is expedited by the use of labor-saving tools, jigs, etc. It does seem that a garage business, built up on a firm foundation of machine tool equipment, with promptness and careful inspection of finished jobs thrown in, might prosper, and at the same time send away satisfied customers.

Book Reviews

Year Book of the American Institute of Electrical Engineers. Five hunderd and fifteen 6x9-in. pages. Board covers. Published by the American Institute of Electrical Engineers, 33 West Thirty-ninth St., New York City.

The 1924 year book of the A.I.E.E. contains not only the names and addresses of the members, both alphabetically and geographically arranged, but also the constitution, by-laws, resolutions, report of the board of directors, committee lists and general information embracing the aims of the association.

Fowler's Mechanics' and Machinists' Pocket Book, 1924. Edited by William H. Fowler. Published by the Scientific Publishing Co., Manchester, England. Stiff paper covers 448 pages 3¾ x 6 in. Price 2 shillings net.

This little book is the sixteenth annual edition and contains a synopsis of practical rules for fitters, turners, millwrights, erectors, patternmakers, foundrymen, draftsmen, apprentices and students.

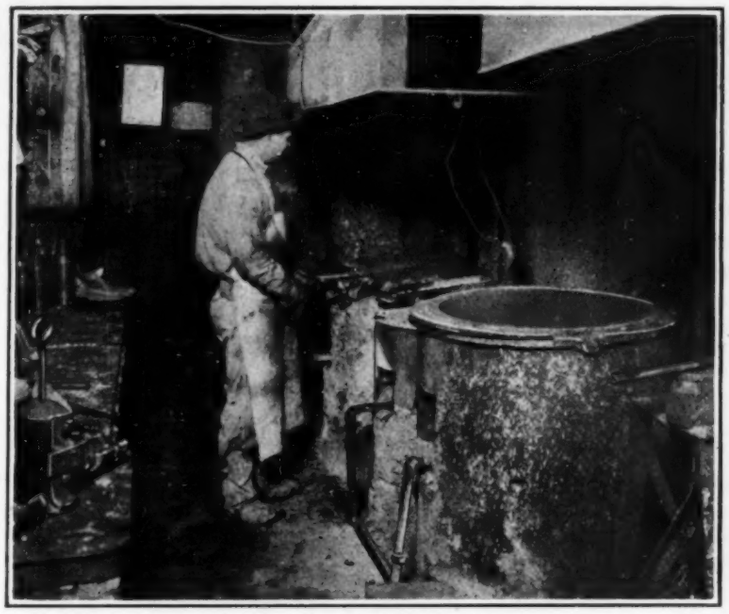
In addition there are contained such various tables and data usually found in books of the kind.

Fowler's Mechanical Engineer's Pocket Book, 1924. Edited by William H. Fowler. Published by the Scientific Publishing Co., Manchester, England. Stiff paper covers. 559 pages 3¾x6 in. Price 3 shillings net.

The present volume is the twenty-sixth annual edition and contains such rules, tables, and data as would be expected to be found in a book bearing its title.

Errata

On page 375, Vol. 60, two typographical errors appear. In the illustration accompanying the article, "Formula for the Bore of a Serrated Splined Hole" by Harold R. Sleeper, the angle b should be measured from the side of the serration to a horizontal line through the apex, instead of to a vertical line, as shown. Also, in the adjacent column the final value for Y in the fourth line from the bottom of the page should be $\frac{F^2}{2H}$ instead of $\frac{F^2}{H}$ as given. This value should also be used in the last equation.



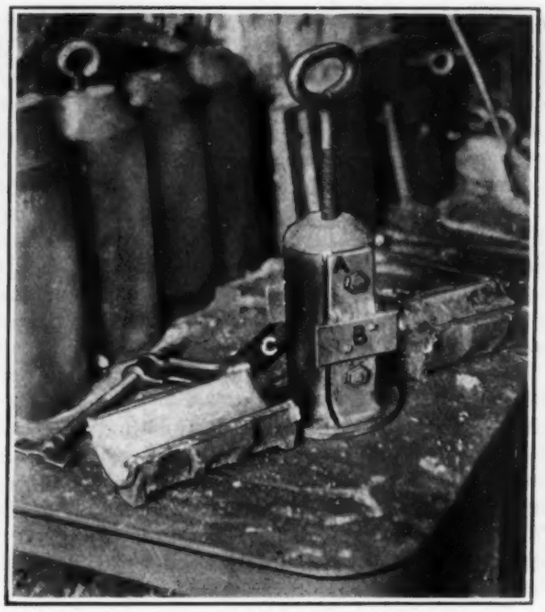


Fig. 1—The babbitting room. Fig. 2—Babbitted boxes and mandrel

Babbitting Brasses for Subway Trains

By Fred H. Colvin
Editor, *American Machinist*

Simple mandrels used for holding brasses in position for babbitting—A small department where two men handle four tons of babbitt per month

THERE are few items that affect railway service more directly than the bearings on which the cars run. "Hot boxes" are not uncommon in any kind of railroading, but they are especially undesirable in subway service. Extreme care in selecting bearing metals, and an original design of brasses have made hot boxes almost unknown in the subway service of the Interborough Rapid Transit Company.

The present babbitting room of the 148th St., New York, shop is congested owing to lack of space in the

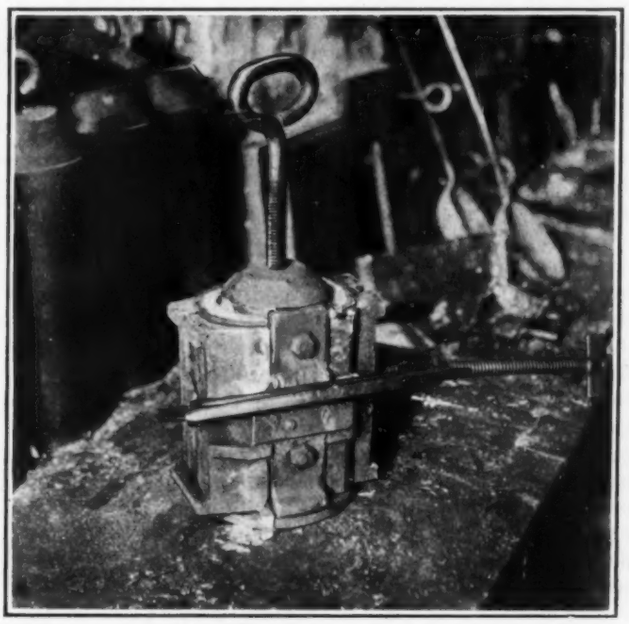


Fig. 3—Pouring the metal. Fig. 4—Two brasses after pouring

old shop. But new shops are being erected and better quarters will be found for this very important department. In spite of the cramped quarters, however, excellent results are obtained, some of which can be credited to the two men on this job who have had such long experience that they are familiar with all the little points to be watched in securing good bearings.

A general view of the babbitting room is shown in Fig. 1, with the furnaces for melting off the worn babbitt, for re-tinning the brass and for melting the babbitt which is to make the new bearing surface. The furnaces are gas fired. Some of the molds or mandrels are shown on the bench at the left.

The construction of the mold or mandrel can best be seen in Fig. 2. The mandrel is the diameter of the axle, less the amount left for finishing. On each side is a plate *A* which holds the brasses the correct distance from the mandrel to give the desired thickness of babbitt, while the cross plate *B*, locates the brasses. The mandrel is flared at the lower end to give the desired radius to the babbitt at this end. The clamp *C* holds the two brasses in place for pouring as shown in Fig. 3. Mandrels of various sizes are shown at the left of the mandrel and brasses.

Some luting between the brasses and the mandrel is necessary to prevent leakage of the molten metal as it is poured. Both clay and heavy sheet asbestos are used for this purpose. Fig. 4 shows the effectiveness of the luting by the very small amount of babbitt to be seen outside the mold.

Two men in the babbitting department take care of all the brasses needed in overhauling 35 cars a day, and handle about 4 tons of babbitt a month on this work.

His Majesty—The Customer

By F. K. Rhine
General Export Manager the General Fireproofing Co.

For the customer is the final judge—the court of last resort. On his decision rests our fate—failure or success. We cannot make a buyer buy—except in unusual instances that are not typical and can therefore be left out of consideration. Without sales there would be no business—and no need of formulating policies. Everything else hinges on our ability to sell the goods; and every policy and practice should contribute to making it easy and advantageous for the buyer to place orders—and to keep on placing orders. Other things must be considered, of course; for making the sale is only the beginning, and even the collection of the payment is by no means the end. There is no end. A successful business must keep right on going, holding old customers and gaining new ones. A business is unhealthy that is not constantly adding new names to its list of friends and clients; but that business is sick unto death which cannot retain its old customers. Repeat-orders produce the real profits—not, as a rule, first orders. And, assuming a product of merit which can be sold at a price the foreign buyer can afford to pay, the ability of the exporter to hold his trade and to build a permanent trade, under the new world conditions or under any conditions, is primarily a question of right policy and practice. Sound policies must protect our own interests, of course; and we must see to that for ourselves.

Excerpt from speech delivered at the Export Managers' Meeting, New York, March 18.

Motor Shop Problems

Making and Pricing Spare Parts

By Frank C. Hudson

IT IS rather interesting in view of the present extent of supplying spare parts for automobiles to learn of the attitude of one of the early companies toward this problem. Spare parts, or "service" as we call it now, was a side issue.

The concern mentioned found that its spare parts business one month rose to $1,800. A meeting was called to impress upon the engineers the fact that something was wrong with the car to need so many spare parts to keep it running. But in spite of improvements during the 19 years that have intervened, this company now does a service business of a million dollars a month. And the same man is still in charge.

The making of spare parts for obsolete models is quite a problem. For current models it is simply necessary to increase stock orders whatever percentage may be necessary. But for last year's car, or for one of ten years ago, it's a different matter.

A few concerns have a separate shop for service parts. As fast as models are discarded, all tools, fixtures and special machines go from the main plant to the service shop and orders are put through in such quantities as experience dictates. Where the obsolete parts can be made on the present-day machine, this machine is sometimes "borrowed" to make up a supply of such parts. In some cases the machine is even moved to the service shop for this purpose. One big concern has a practice of keeping a three months' supply of spare parts always in stock and ready to ship almost at a moment's notice.

The pricing of spare parts is a problem that may have more to do with the selling of new cars than we realize. Abnormally high costs of spare parts always leave a bad taste in the mouth of the purchaser. And the reputation of excessive charges for replacements does not help to sell a new car to the victim.

What Some Cars Would Cost If Assembled from Component Parts

Henry Ford deserves credit for being one of the pioneers at putting prices for spares at a minimum. Most other large builders have more or less followed suit. But there are a few still outside the fold. One well known car that sells for about $1,500 would cost $2,400 if parts were bought and assembled. This is a fair average. Another car, however, and a good one, that sells for $2,000, is reported to cost over $18,000 if bought piecemeal.

It is not a simple problem, however, as there is a constantly increasing cost in carrying spare parts as a model gets older. Parts for current models should be very reasonably priced, but it seems perfectly fair to increase the cost of spares as the years go by. After ten years they might be listed as specials and charged accordingly.

Such a policy might have an effect on the final scrapping of cars and in this way help to solve the problem of used cars, that now confronts the industry, not only as a whole, but all its branches as well.

Ideas from Practical Men

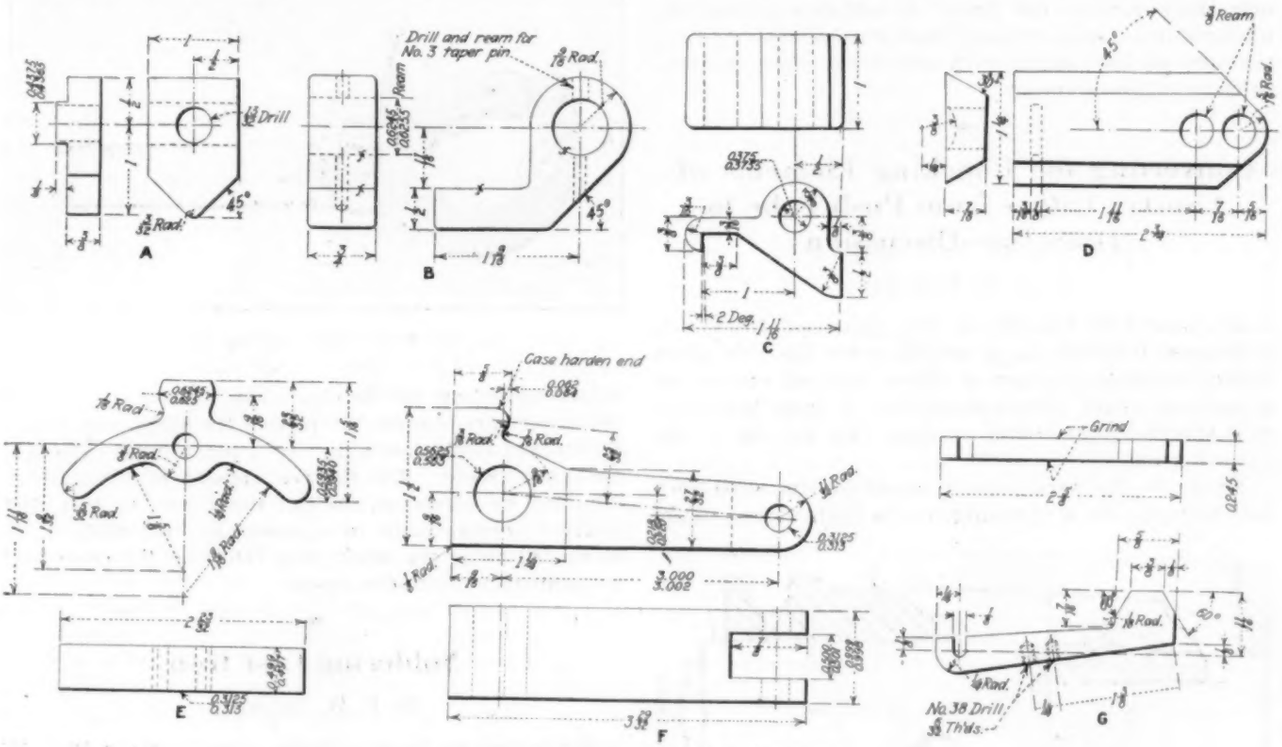
Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

Making Small Machine Parts in Strips

BY K. H. CRUMRINE

Many small machine parts which, when machined singly, are difficult and often quite expensive to make, can be made more easily, and often at less expense, if machined in strips. Such strips may be machined on shapers, milling machines or planers, depending upon their size, shape and the quantity required, and are usually sawed to more or less accurate lengths on the milling machine, bandsaw or hacksaw.

Usually, the more intricate the shape of the pieces to be made, the greater the saving. If the limits of dimension are not close, this saving is in machining



Parts adapted to machining in strips

only a very few minutes to put this accurate size on a hundred pieces. The strips are then cut upon a milling machine to the finished length, and the 45-deg. bevel is machined as a later operation.

On parts *B* and *C* no great accuracy is required, and the lots of each are usually small. It has been found economical to make these parts in strips of twelve, finishing them on a shaper. Part *B* is made from steel $2\frac{1}{4}$x$1\frac{3}{4}$ in. and is finished all over, the 45-deg. bevel being cut after all other surfaces are finished. These pieces are cut to length and the sides are finished by grinding on a rotary surface grinder. Part *C* is made from $1\frac{1}{4}$x$1\frac{3}{4}$-in. steel. These parts, if made singly, would be very expensive unless special formed milling-

time only. However, on certain pieces of very simple shape, the combination of accuracy with uniformity easily obtained, results in a considerable saving, not only in the time of machining the parts themselves, but in the time consumed in fitting or assembling later on. The only close dimension required on the part shown at *A*, is the width of the tongue, and we make these pieces on a small 10-ft. planer in strips the whole length of the table. The material used is $1\frac{1}{2}$x$\frac{1}{2}$-in. cold-rolled steel. The set-up is extremely simple and when the tool is set for finishing the tongue, it is a matter of cutters were used, but when made in strips they are produced quite economically.

Part *D* requires both accuracy and uniformity, and is difficult to make when machined singly upon a miller or shaper, but we find that when made in long strips upon the planer it becomes a comparatively simple matter. The strip is first planed to thickness and a trifle over width. Then the lengths are measured off and one of the $\frac{3}{8}$-in. holes drilled in every third or fourth piece. The strips are then laid on the planer table directly over one of the T-slots and bolted down

through the above-mentioned holes, the front end of the strip projecting a trifle over the chip pocket in the table for gaging. While in this position, both bevels are planed at the same setting, thus assuring uniformity throughout the length of the strips.

It is on such parts as *E*, *F* and *G*, however, that the greatest saving is made. These parts are more or less irregular in shape and intricate in design, and must be machined accurately in certain places. These parts are all made in comparatively short strips averaging approximately two feet in length. When making the parts *E* and *F*, several of the strips are put on a planer, the bulk of the metal being removed and the simpler plain surfaces finished. They are then taken to the milling machine where the more difficult surfaces are finished with special formed cutters, one strip at a time. Part *G* is finished complete upon the planer ready for sawing.

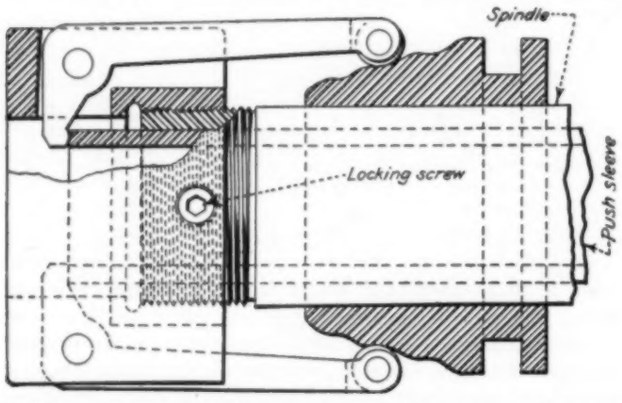
Savings effected by this method are often really very remarkable for, although the time for machining a single strip may seem very long, when it is divided by the large number of completed parts, the time per piece is often unbelievably short. For instance, a 10-ft. strip for the part *D* can be set up and both bevels accurately planed to gage in approximately two hours. Since a 10-ft. strip makes forty pieces, this amounts to only three minutes per piece. In addition to this, the uniformity is unquestionable and it is possible to turn out very accurate parts with almost the same economy as those of less accuracy.

Converting the Chucking Elements of Capstan Lathes from Push-Tube to Draw-Bar—Discussion

By A. W. Freeman

On page 118, Vol. 60, of the *American Machinist*, F. Osgood Hickling, in an article under the title given above, attempts to show a better way of converting a push-out collet arrangement into a draw bar, than that shown by the writer on page 772, Vol. 58, of the same journal.

No doubt the arrangement would do the work very satisfactorily on a chucking device such as shown by



Collet-operating attachment for No. 4 Warner & Swasey turret lathe

Mr. Hickling, but would not in any way adapt itself to the chuck on the No. 4 universal Warner & Swasey turret lathe, a sketch of which is shown herewith.

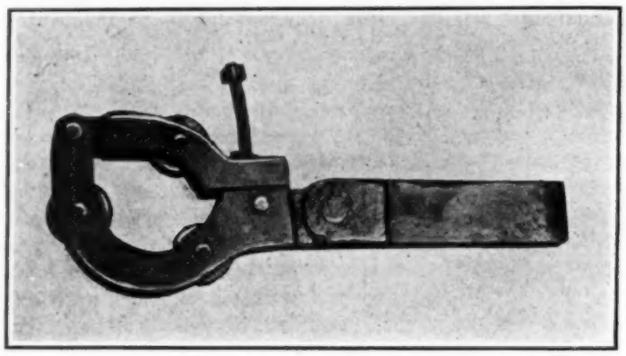
Referring to my previous article, it will be noticed that the device shown therein is not complicated with a number of small working parts but is very simple, and the machine can be changed from push out to draw bar in less than two minutes time. It would certainly take much longer to change and adjust the arrangement shown by Mr. Hickling.

A Three-Roller Rolling Tool

By Tom J. O'Rielly

The principal objection to the use of a rolling tool of the usual single-roller type, is that the amount of pressure which must necessarily be exerted on the tool does more or less damage to the cross-feed mechanism of the lathe. This objection has been eliminated in the tool described herewith, which is in use in the shops of the Terminal Railway Association, St. Louis, Missouri.

The frame of the tool is made in three parts, as shown in the illustration. Two of the parts carry the three rollers and are hinged together, and the lower one of the two is hinged to the shank, so that the tool



A three-roller rolling tool

is self-adjusting for height. The lug on the end of the upper part is slotted to receive the hinge-bolt, which is attached to the lower part by a pin, allowing the bolt to swing freely. The desired amount of pressure is obtained by screwing the nut down on the bolt, the toolpost serving only to support the tool while it is being fed along the work, thus relieving the cross-feed mechanism from undue stress.

Soldering Cast Iron

By E. W. Riesbeck

Sometimes we have a broken small casting that we would like to mend temporarily with a joint of sufficient strength to allow the broken part to be used as a pattern from which to mold a new casting. The job can be done in the following manner:

Clean the broken ends *thoroughly* of all dirt, grease, paint, or other foreign material and then dip them in the blue vitriol solution used by toolmakers to "copper" dies and other bright pieces of steel so that they can be laid out. After the parts have been well coated by the copper deposit and allowed to dry, they can be soldered together by ordinary means and will hold quite strongly enough for the purpose if the molder is at all careful.

Flow of Metal Under Pressure—Discussion

BY F. M. A'HEARN

I was greatly interested in the article under the title given above, by Clifford H. French, on page 187, Vol. 60, of the *American Machinist*, as it reminded me forcibly of a case that happened some years ago.

The story is this: A railway machine-shop was destroyed by fire. That was bad enough, as a transportation company must needs carry on regardless of obstacles, but there were certain mitigating circumstances that eased the blow. One was that as the shop

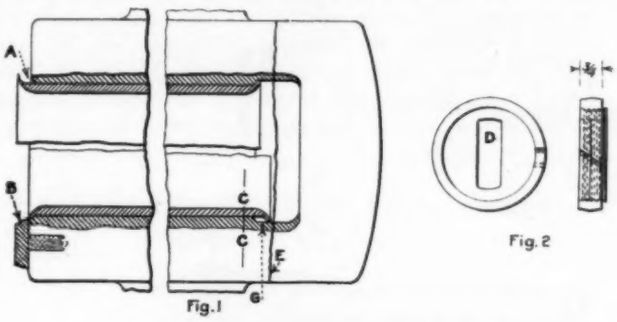


Fig. 1—The cylinder and lining.
Fig. 2—The expanding ring

was only an auxiliary plant, and practically all the tools were survivors of the civil-war era, their possible replacement with modern tools would be an asset to the mechanical department. Counteracting this, however, was the fact that all the car-wheel fitting equipment owned by the company was housed in the same building as the machine shop, and only fared better than the machine tools, by the fact that the car-wheel equipment was all modern and of fairly husky design.

The morning after (February and zero), we cleared away the line and countershafts festooned over the tools, and began the job of overhauling a hydraulic car-wheel press on the spot, pending construction of a new wheel shop. Withdrawing the ram, it was found that the copper lining of the cylinder was loose. Telegraphing the maker brought the information that the lining was rolled in place and could be reset only by shipping the cylinder back to the builder. This looked somewhat uncertain regarding the probable time when wheel mounting could be resumed, and, after a hasty council, it was decided to build a portable roll and attempt to reset the bushing. The outer end of the bushing appeared to be about ¾ in. thick, and no great difficulty was anticipated in getting the job finished.

An expanding roll was rigged up, and, with a motor on the end of the long shank, the bushing was rolled by starting at the open end and running the roll the length of the bore, backing out by reversing the motor. The job did not take long and looked good, nor did tapping the inside with a hammer indicate any wrong condition.

When the press was put in service, everything went well until a pressure of about 4,000 lb. per sq.in. was built up, when the lining moved out of the open end of the cylinder as at *A*, Fig. 1, and stopped there, leaking badly between the lining and the cylinder wall. The exposed end showed that instead of the liner being ¾ in. thick, it was about ¼ in., and beaded over at the outer end. The roll was adjusted and again run through, the projecting end chipped and beaded, and, as a safeguard, a steel ring *B*, secured with close-spaced ¾-in. patch bolts, was applied to the open end of the cylinder, covering the end of the lining. A little more pressure, and the steel ring and patch bolts were promptly lifted out by the roots, the liner stopping in about the same position as before.

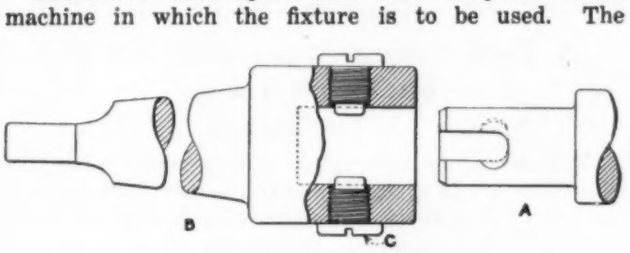
As it did not seem possible to hold the liner by the methods tried, and having discovered that the ram did not extend back the entire length of the bushing when in full return position, a third and successful tightening was accomplished by inserting an expander ring, on line *C-C*, Fig. 1. The ring was about ¾ in. wide, crowned on the outer diameter, and bored and threaded taper on the inside. An open-hearth plate, having a slot punched across the center to provide a passage for the water, and also to afford a means for tightening the ring, was turned and threaded taper to fit the inner diameter of the ring. The ring was parted at one side by a hacksaw-cut and threaded over the plate; the assembly was then placed in the cylinder and tightened by the use of a 4x1-in. bar in slot *D* and heavy wrenches. Ring *B* was left off and the projecting end of the liner again chipped and beaded into place. The liner gave no farther trouble. Several years later, when the cylinder was scrapped, due to a break through section *E*, it was discovered that a counterbore was provided at the inner end of the lining, and that the inner end, after the liner was rolled, had been beaded down into the counterbore. Tightening with the portable rolls had stretched the lining and caused it to recede at *G*, which explained the reason for its moving out as at *A*, and stopping there.

A Driver for Boring Bars

BY N. E. BROWN

When designing a number of piloted boring bars to be used in connection with a boring fixture, it is desirable in the interest of economy to make them with ends as shown at *A* in the sketch, instead of with a taper shank on each bar, and provide a collet, or driver, as shown at *B*, to drive them.

The driver has a taper shank to fit the spindle of the machine in which the fixture is to be used. The



Driver for boring bars

shouldered end of each bar is a snug fit for the hole in the outer end of the driver, and is slotted on opposite sides to match the screw-studs in the latter. The inner end of each slot is enlarged slightly in the direction of rotation to prevent the bar from working out.

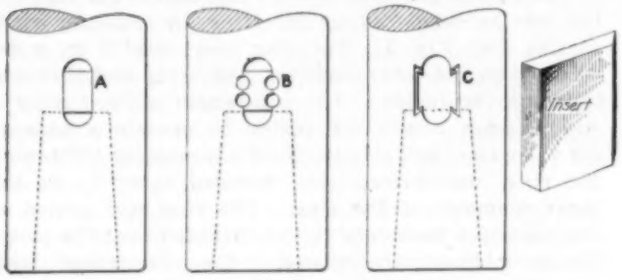
The driver remains in the machine spindle, and when withdrawing a bar for the purpose of changing to another, the operator has only to give it a slight turn forward to disengage it from the screw studs and pull it out of the driver. The screw-studs *C* should be made of good material and carefully hardened.

Repairing Drill Press Spindles—Discussion

By George Siegrist

Recent discussion of methods of repairing the spindles of drill presses leads me to contribute my own experience along that line.

We had two radial drill presses, the spindles of which had No. 4 Morse taper holes, and the driving slots in each were so badly worn that repairs were necessary. I first fitted two pieces of mild steel roughly to each



A new tang slot in an old spindle

slot, and drove them in, one from each side, as at *A* in the sketch. This enabled me to drill the holes as shown at *B*, four holes half-way through from each side of the spindle.

Next the filling pieces were driven out and the projecting metal between each pair of holes chipped away, leaving room for a slotting tool. Taking the spindle to the slotting machine I cut two dovetails clear through, one on each side of the tang slot as at *C*, and chamfered the edges about $\frac{1}{16}$ in. on both sides of the spindle. The dovetails were made with a small amount of taper, owing to the spring of the slotting tool.

Inserts were then made from the toughest carbon steel that could be machined, and fitted tightly in place, after which the ends were peened down to fill the chamfers and smoothed off with a file to match the contour of the spindle.

With a trifling amount of fitting the tang slots were as good or better than when new, and, should they ever need renewal, it is necessary only to drive out the old inserts and fit new ones.

A Back-Facing Attachment for Use on Turret Lathes

By I. F. Yeoman

The following description and accompanying line drawings are of a simple and inexpensive tool to be attached to a turret for facing the back ends of bronze bushings, thus enabling the facing of both ends at one chucking.

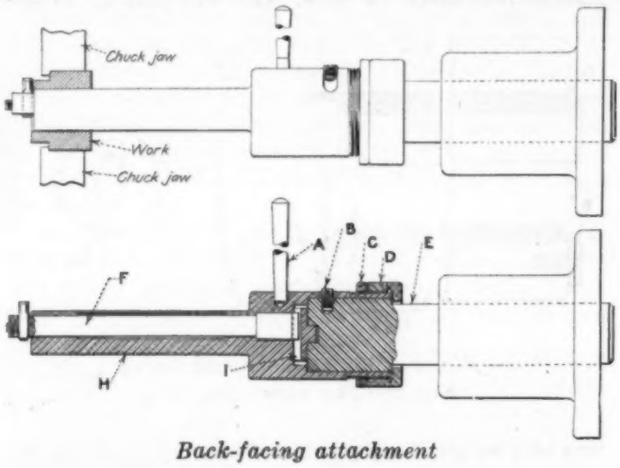
As the bushings were used only as spacers, it is obvious that the use of the tool as shown saves a great amount of time on quantity production.

It will be noted that the spindle *F* is carried in the body *H*, the bearings for the spindle *F* being bored eccentrically with the bearing in the body *H*, which fits over the shank *E*. Thus, when the body *H* is rotated by the handle *A*, the eccentric action moves the spindle *F*, carrying the facing cutter upward or downward according to the direction of rotation.

So that the spindle *F* cannot revolve, the rear end is tounged and fitted to the vertical slot in the retainer *I*, the rear side of the retainer being tongued at right angles to the vertical slot, and fitted to a slot milled in the shank.

The retainer moves longitudinally and compensates for the eccentric action of the spindle *F*, and yet retains same in a fixed position, rotatably.

The body is slotted for a distance around the circumference equal to the necessary movement of rotation to raise and lower the cutter. Through this slot, the screw *B* is inserted in the shank and acts as a stop. The collars *C* and *D* hold the body to the shank and provide means of taking up wear. The material used



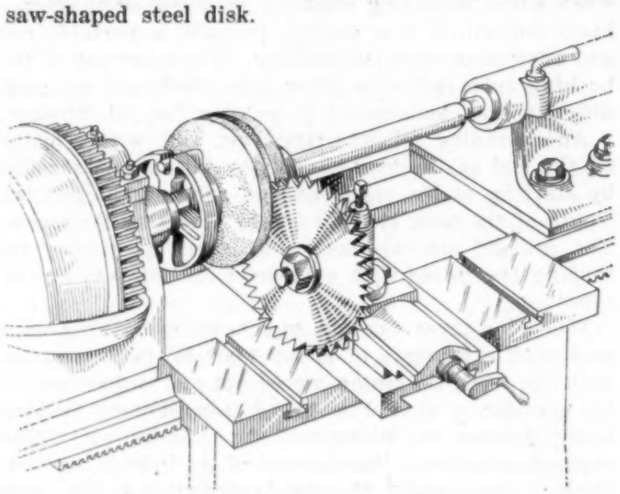
Back-facing attachment

throughout is machinery steel. The outside diameter of the body *H* is concentric with the bearing on the shank, and the forward end pilots into the reamed hole in the bushing, and forms a very rigid and non-chattering tool. This tool is not to be recommended for heavy facing in steel, unless it can be made very heavy.

Splitting a Grinding Wheel with a Steel Saw

By John J. O'Wril

Here is a kink, the bare statement of which seems absurd; yet I have tried it out on a carborundum, a corundum, and an alundum grinding wheel and found it to work. It is the splitting of such a wheel into two or more thinner wheels by means of an unhardened saw-shaped steel disk.



Splitting a grinding wheel with a steel saw

Let us assume a grinding wheel 1¼ in. thick by 6 in. diameter, of which we want to make two wheels of the same diameter but each approximately ½ in. thick. The grinding wheel is mounted on an arbor and the arbor placed between centers of a lathe. An unhardened steel disk, 7 in. in diameter by about ⅛ in. thick, having V-shaped teeth filed around its periphery, is mounted in a suitable holder that will allow it to revolve freely.

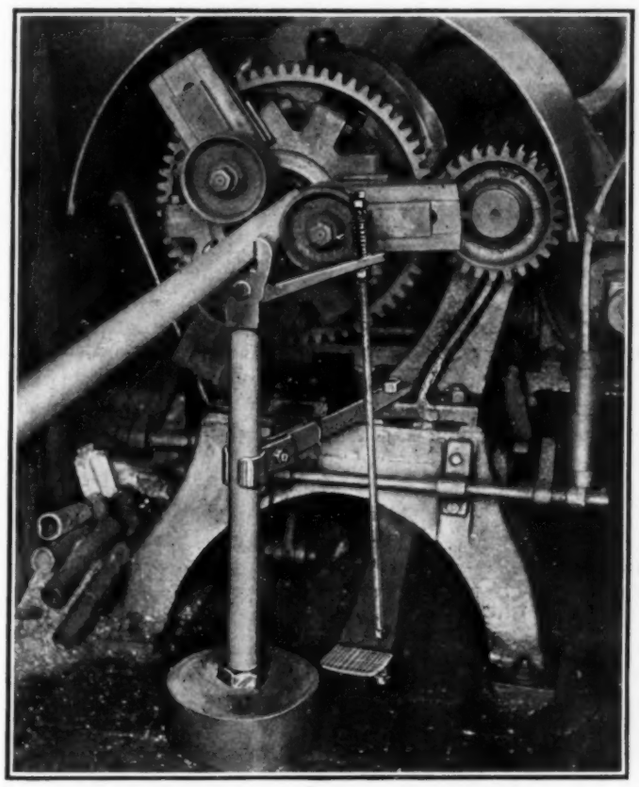
The holder is clamped in the toolpost of the lathe and the disk fed against the grinding wheel as a cutting-off tool would be fed. The lathe is run at the highest open-belt speed and the revolving wheel drives the saw-shaped cutter by contact.

In my experiments the cutter was not hardened because of the difficulty involved in keeping it from warping. The teeth were almost worn away in splitting one wheel, but I assume they would have lasted longer if they had been hardened.

Support For Use With Flue Welder

By Henry M. Clary

The illustration shows a support or "grab" that was built for use in connection with a Hartz Flue Welder and is in use in the shops of the Terminal Railway Association, St. Louis, Mo. The grab consists of a



Support for use with flue welder

section of tubing screwed into a heavy cast iron base, and with a pair of jaws attached to the upper end as shown in the illustration. The fixed jaw is integral with a shank that is driven into the upper end of the tubing, while the movable jaw, which is integral with a lever, is connected with the foot lever of the rolling machine by means of a rod. When the foot lever is pressed down to start the machine, the action also pulls the lever end of the movable jaw down, closing the jaws and gripping the tube. This relieves the operator from having to hold the tube with his hands while the rolling operation is in process. A spring between the lever and the upper end of the rod takes care of any inequalities in the size of the tubes. The grab is anchored by means of two straps that are clamped to the grab and bolted to the machine as shown.

Tool for Turning Long Rods of Small Diameter

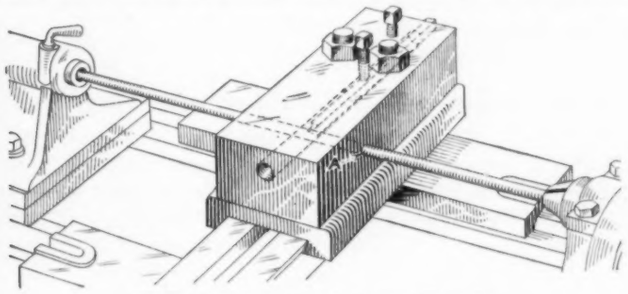
By John J. O'Wril

Having twenty ⅜-in. diameter brass rods 8 ft. long to be reduced over the whole length to a diameter of 0.307 in., I adopted the method of turning them set forth in the accompanying sketch.

A convenient block of cast iron was picked up, two holes drilled through in the direction of the shortest dimension to take the bolts by which the block was held to the tool slide of the lathe, one hole drilled lengthwise large enough in diameter to allow a ⅝-in. square toolbit to be pushed into it, and a ⅜-in. hole, *A*, drilled at a right angle to the latter to take the rod to be turned. The ⅜-in. hole was drilled to intersect the longitudinal hole, at a point to bring the rod to be turned in proper relation to the turning tool. A couple of setscrews held the tool in place.

The modus operandi was as follows: One of the rods was put through the lathe spindle and gripped in a ⅜-in. collet with somewhat more than four feet of its length projecting. The improvised tool, bolted to the tool slide of the lathe was brought up to the end of the rod, which was entered in the hole *A* until it met the turning tool. The lathe was then started and the longitudinal feed thrown in; the tool having been previously set to turn the right diameter by the cut and try method on short pieces.

To prevent the free end of the turned rod from whipping about as its growing length extended from the tool,



Box tool for turning small rods

the center was taken out of the tailspindle and the tailstock moved forward so that the hole in the spindle supported the rod.

When the carriage reached the headstock the rod was taken out and reversed, the smaller diameter now necessitating the use of a drill chuck instead of a collet to hold it while the remaining portion was being turned to match the part previously turned.

I do not claim great accuracy for this tool, though the principle is capable of elaboration to any degree of refinement. My finished rods calipered within 0.001 in.; which was plenty good enough for the job they were intended to be used upon.

American Machinist

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KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

The Top Sergeant of the Shop

FROM the Military Academy at West Point comes this ancient classroom yarn. An instructor propounded to his class a problem that involved the erection of a flagpole of given height and weight. The class struggled with the problem and submitted various more or less ingenious solutions. After everyone had been heard, the instructor said curtly, "All wrong. You would simply say 'Sergeant, put up that flagpole.'"

That, briefly, is the job of the top sergeant in the army. He is expected to know how to do every job that comes within his line of duty, and some that do not, and to see that they are done promptly. In the shop the same omniscience is expected of the foreman and ninety-nine times out of a hundred he produces the goods.

We hear marvelous tales of the prowess of foremen of the last generation. All honor to them and the things they did with their limited means. Let us not forget, however, that the modern foreman is faced with a multiplicity of problems of a complexity undreamed of by his predecessor. Just as the engineer of the last century, who was usually an all-round practitioner capable of success in the civil, mechanical or electrical fields has been succeeded by specialists in each, or even in one subdivision only, so has the all-round foreman of the old shop been succeeded by the specialists of the big, highly organized shop of today.

There is this difference—the engineer who bumps up against something a little out of his regular line can usually pass the buck, the foreman hasn't anybody to whom to pass it. The foreman, therefore, is entitled to all the help in the way of training and education that his employer can give him. It will be effort well spent and productive of big returns.

Has the Country Lost Confidence in Congress?

SEVERAL days ago one of the best known of the Washington newspaper correspondents observed that the Senate was beginning to wake up to the fact that it has lost the confidence of the people. The occasion for the soul searching that led to this important discovery was the sharp challenge issued to the Senate by President Coolidge. It aroused senatorial resentment by its plain language but it was an understatement rather than an exaggeration of general sentiment.

One of the politician's principal requisites is supposed to be his ability to read public sentiment, to know what people want. Judging from appearances most of the gentlemen who now meet daily in the Capitol are not even good politicians. The voters are sick and tired of the kind of investigations indulged in by the Senate during the last four months. That the investigations have been partisan only, has been discouragingly obvious. The daily press has been scathing in its denunciation of the methods employed by the investigators.

What will happen to senators now in office is of small moment. Some of those whose terms expire shortly have failed of renomination and others are sure to meet the same fate. The serious effect on the country is the loss of confidence in the Senate as a deliberative body, the first interest of which should be the best interests of all the people. Some men believe that the end of democratic government is in sight and will be hastened by the performances of the present Congress. We do not agree with this view but we do feel that serious harm has been done and that only time can remedy the situation. The only good feature is that the average citizen may be so aroused that he will take an interest in politics and see to it that he is represented by the kind of man he wants instead of by the kind the local organization sets up for him.

Steady Work Necessary to Maintain an Organization

THE question of steady employment is serious in many industries and the railroads in some sections are seriously affected by it. This is particularly true where the traffic of the road fluctuates greatly with the seasons in either the passenger or freight traffic. Laying off men, especially with little or no warning, makes it extremly difficult to maintain an effective organization.

Apprenticeship systems or other methods of recruiting men to handle the intricate work of keeping motive power and rolling stock in operation, cannot prove entirely successful unless there is more likelihood of steady employment than exists on some railways. Rent day and grocery bills come around with little regard to the railroad seasonal business.

It is partly for this reason that some railway executives favor, or at least do not discourage, the building of an occasional locomotive or car or machine, for their own use. As a rule no time limit is set on the work and it seems to fill in the time when other roads lay off its shop men. They are often aware that locomotives or other equipment may cost somewhat more than as though bought in the market, but it enables them to not only keep their organization together but to keep it loyal and interested.

There are cases where the work might better go toward maintaining rolling stock or locomotives. But managements have odd ideas at times, regarding the distribution of expenditures, and there are methods of accounting which are not always clear to the layman.

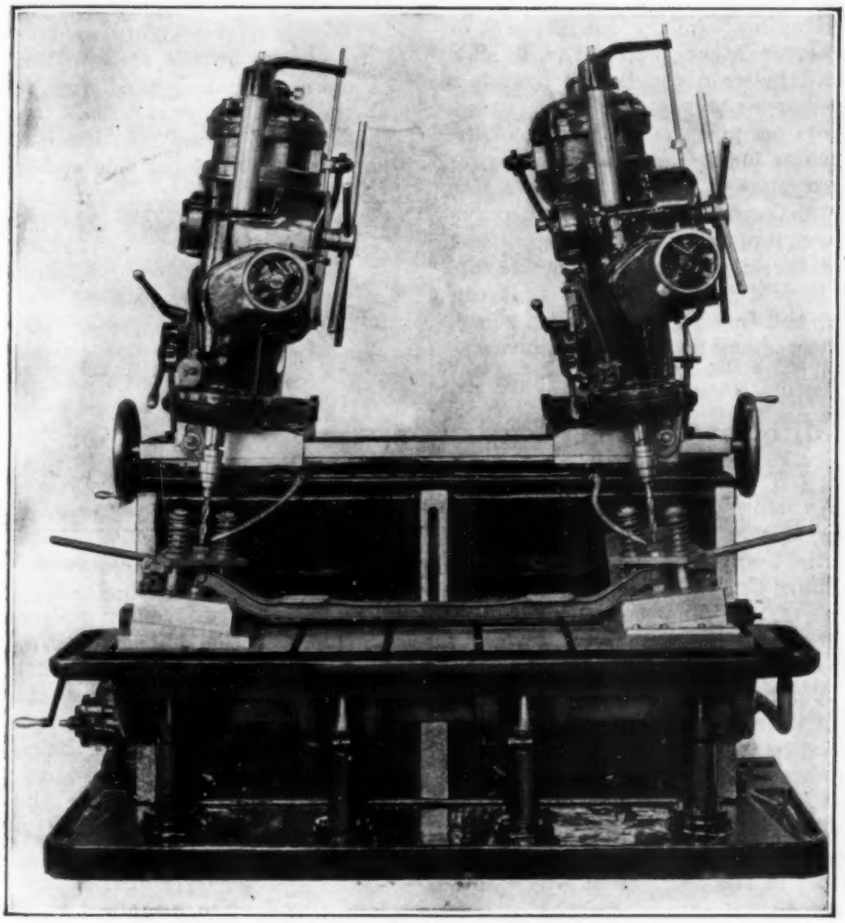
Whatever the cause, or whatever the remedy, no plant can expect to hold its men and its efficiency without providing fairly steady employment. This question is now receiving widespread attention in a number of industries and the railroads will do well to see what can be done along this line in managing their own shops.

The cost to the United States of the war, during the last ten months, was $44,000,000 per day. Industrial mobilization, now going on, is for the purpose of shortening the next war, should we have one. Multiply $44,000,000 by 7 and you will see what would be saved by shortening the war only one week. Then try a month of 30 days. Moral: Help the cause of industrial mobilization when you have the opportunity.

Shop Equipment News

Minster Front Axle Drilling Machine

A machine for drilling the king bolt holes in front axles for automobiles has recently been built by the Minster Machine Co., Minster, Ohio. This drilling machine is of the duplex type arranged to drill both holes simultaneously, and is shown in the accompanying illustration.



Minster Front Axle Drilling Machine

The machine consists essentially of two single-spindle drilling machine units mounted on a single bed. The units are carried on saddles that slide on a planed bearing, the distance between the units being adjusted by means of the handwheels at either end of the slide.

Since the holes are drilled in the axle at an angle, provision is made for setting each drilling unit at an angle as shown in the illustration. Each unit is pivoted on the inside near its saddle, an adjusting screw, vernier and clamp being provided for accurate setting. This angular adjustment, together with the variable center distance, makes the machine available for a variety of axles with different distances between holes and various angles of holes.

It will be noted that each unit is motor-driven, the motor of each unit being mounted at the top and geared directly to the machine. The mechanism of the drilling units is the same as that of the standard No. 9 drilling machine manufactured by this company and described on page 341, Vol. 59, of the *American Machinist*.

The fixture provided to hold the axle in position on the table is arranged to allow a considerable variation in the length of the forgings. The block at the left-hand end of the table is fixed, the one at the other end being adjustable and arranged to slide longitudinally to suit the end of the forging. The drill bushings are cup-shaped at their lower ends and fit over the forging, being held in a bar which is pressed downward by coil springs.

In the machine illustrated these bars are equipped with individual hand levers for raising, but a treadle can be furnished by means of which both bushings can be raised from the work simultaneously. Cup-shaped members are also provided in the bottom blocks of the fixture, so that the fixture is loaded by simply placing the ends of the forging in these depressions and releasing the bars that carry the drill bushings.

American Chip Crusher

The American Crusher & Machinery Corp., 1 Madison Ave., New York, N. Y., has recently placed on the market a machine for crushing metal turnings and chips. The machine has been designed to reduce this material to such a size that it will be easier to handle and transport and can be satisfactorily melted up and reclaimed.

A further advantage obtained through the crushing of chips to small particles is the saving of a greater proportion of the oil in the mass of material. It is claimed that practically all of the oil can be reclaimed from crushed chips, the bulk being about one-fifteenth that of the original bushy turnings.

The machine is built in two sizes. The type SZ-15, shown in operation in Fig. 1, has a capacity of about 5 tons of chips per eight-hour day and can be furnished either with a motor drive or arranged for belt driving, as shown. A larger machine, designated the type SZ-20, is shown in

Fig. 2, and this crusher will handle about 5 tons of chips per hour. The larger machine is furnished with a belt drive only.

The body of the crusher is mounted on a heavy baseplate and encloses the driving gears and the vertical cutter shaft. It is surmounted by a large funnel-shaped hopper into which the chips are

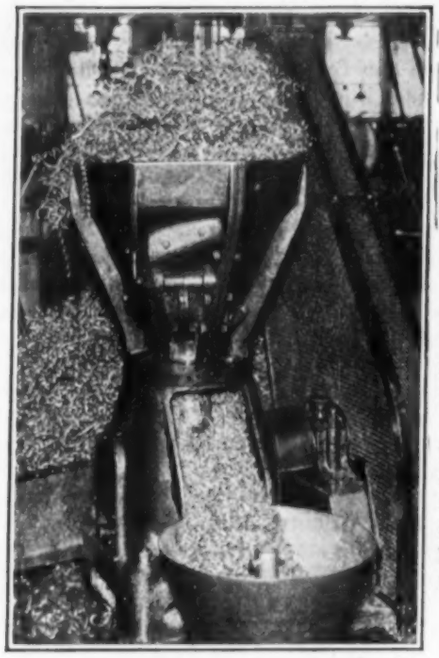


Fig. 1—American Type SZ-15 Chip Crusher

dumped. At the top of the cutter shaft a cutter head is fastened and rotates in the funnel, drawing the chips downward and cutting them into small pieces against fixed blades secured to the inner surface of the hopper.

A rotating knife-head is arranged

Fig. 2—American Type SZ-20 Chip Crusher

in the neck of the hopper and the final crushing of the material is done between this head and a fixed cutter ring. By changing this head and ring it is possible to obtain chips ground to any desired degree of fineness. The effect of these cutters and knives is a combined cutting, tearing, grinding, and crushing action, and after passing the last knives the chips are discharged down an incline at the side of the machine, as shown in Fig. 1.

Should a large solid piece of scrap, a tool, or other large piece of material enter with the turnings, a safety stop in the shape of a shear pin on the driving shaft is arranged to prevent damage to the machine or its driving machanism. Small pieces of stock or other material will slide down between the helical blades in the hopper and be gradually cut up. Doors are provided in the side of the machine for the removal of the larger obstructions.

The smaller machine requires a power input of approximately 4 hp., and the larger size requires 15 hp. It is said that the larger unit can also be used for crushing tin scrap, brittle stampings and similar material.

Milburn Oxy-Acetylene Cutting Tip

An improvement in its line of oxy-acetylene cutting apparatus has recently been made by the Alexander Milburn Co., Baltimore, Md., and consists of a mixing tip with desirable features. This improved device is known as the Super tip.

A renewable seat is provided in this tip so that it is unnecessary to machine or discard used tips. The renewable seat also facilitates the cleaning and maintenance of the tip.

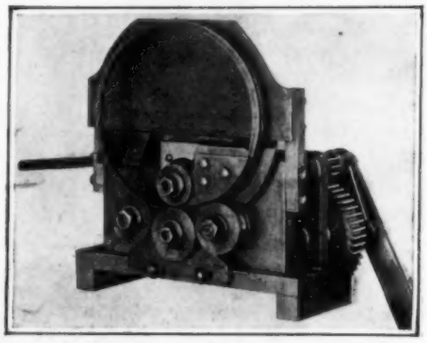
The mixing of the preheating gases takes place in multiple passages in the seat, from which they pass to an annular passage where they are given a swirling motion and additional mixing. From the annular passage the gases are expanded into enlarged multiple passages leading to the orifices in the tip proper. The preheating flames are then projected with increased velocity at an angle toward the high-pressure oxygen jet.

It is claimed that the use of this tip gives a speedier cut, a narrower kerf, and a material saving of gases over the former design. On test, it is stated that 17.5 per cent of the time, 10.9 per cent of the oxygen, and 25.0 per cent of the usual amount of acetylene required, have been saved. This gives a total saving of approximately 18 per cent in the cost of operation. These tips are interchangeable with all sizes of Milburn cutting tips.

Wallace Ring Bending Machine

The Wallace Supplies Manufacturing Co., 1312 Diversey Parkway, Chicago, Ill., has recently added to its line of bending equipment the ring bending machine shown in the accompanying illustration. The machine is intended for bending rings from bars, metal tubing, channels or special sections, and is designed to eliminate the short straight sections sometimes left at the ends of the piece and necessitating hand work to finish the ring.

The material is fed into the machine from the left-hand side and is



Wallace Ring Bending Machine

gripped by the two center rollers. The gripping action is controlled by an eccentric lever at the back of the machine and shown projecting at the left. Two adjustable shoes extend upward between the rollers, being accurately machined to fit the stock. These shoes assist in guiding and forming the metal as it is drawn between the rolls.

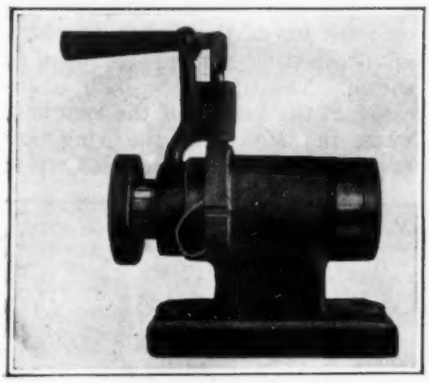
The shoe at the right of the upper center roller is also machined to fit the stock and act as a guide, and a deflecting plate at the left side of the machine causes the end of the ring first formed to clear the rolls as it sweeps around.

The machine shown in the illustration is arranged for operation by hand, but it is stated that a power drive can be furnished, if desired. The hand-operated machine bends the stock at from 10 to 15 ft. per min. The ring being formed in the illustration is 10 in. in diameter and larger or smaller rings can be made on the same machine.

Bemis Milling Fixture

A fixture for holding round stock for slabbing or milling operations is now being marketed by the E. W. Bemis Machine Co., Worcester, Mass.

The device consists of a heavy cast-iron body, in which is mounted



Bemis Milling Fixture

a spindle. The spindle is threaded to hold collets from ⅛ to ⅞ in. in size, the collet being closed by the knurled handwheel shown in the accompanying illustration. The rotation of the handwheel draws the collet back into a hardened ring.

The spindle may be locked in any one of three positions by a locking pin that is arranged to enter notches in the body of the device. The pin is withdrawn from the notches by means of a convenient handle, and the spindle can then be rotated to another position.

Grant Double-End Chamfering Machine

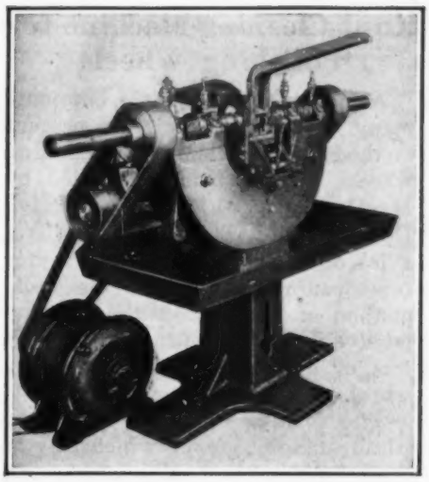
The Grant Manufacturing & Machine Co., 85 Silliman Ave., Bridgeport, Conn., has recently brought out a double-end chamfering machine to handle round stock in all sizes up to 2 in. in diameter by 7 in. long. The cutter heads are designed to take cutters of standard tool stock that may be shaped to produce bevels or chamfers of any depth and included angle desired, or for rounding or facing both ends of the stock simultaneously.

The machine is driven by a single 3-in. belt from a motor on the floor, or from overhead shafting. The first shaft drives the longitudinal shaft through bevel gearing and pulleys on either end of this shaft drive the respective spindles in opposite directions through open and crossed belts. This shaft is supported in bronze sleeve bearings close to the pulleys so that there is practically no overhang.

The feeding mechanism derives its movement through worm reduction gearing from the first shaft, and by means of change gears the rate of operation may be varied to suit the requirements of the job in hand, without altering the speed of rotation of the cutters.

The same mechanism that operates the work carrier also actuates the cams from which the endwise movements of the spindles are obtained, so that the parts are at all times in synchronism. During a complete cycle the machine picks up a piece from the bottom of the feed rack, carries it into line with the spindles, grips it while the machining operation is being performed, and discharges the finished piece through a chute to a receptacle. The sequence of operations is automatic and continuous.

The machine occupies a floor space 30x68 in. and weighs approximately 850 pounds. A gear-driven



Grant Double-End Chamfering Machine

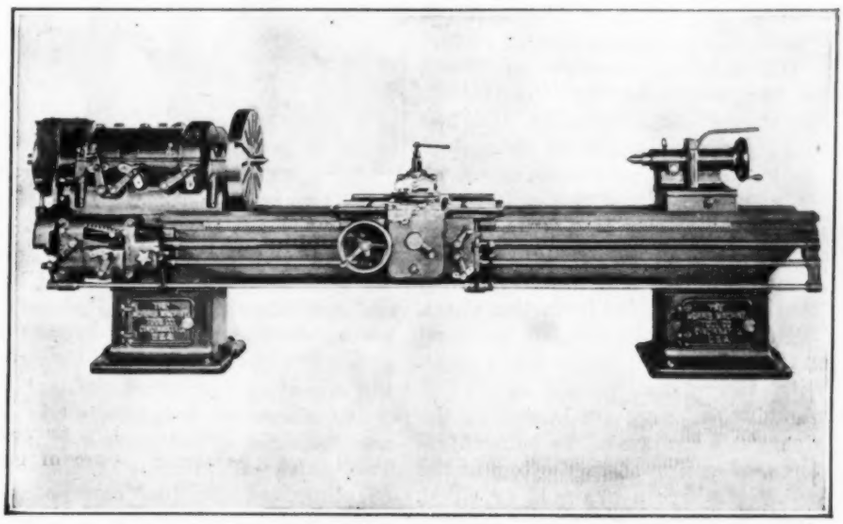
pump and tank for cooling and lubricating compound is supplied, if desired. A basin of generous proportions surrounds the working parts of the machine and drains the compound back to the settling tank.

Morris Geared-Head Lathe with Cabinet Legs

The 22-in. geared-head lathe manufactured by the Morris Machine Tool Co., Court & Harriet Sts., Cincinnati, Ohio, is now being furnished with cabinet legs and a clutch control at the apron. The former model of this machine was illustrated and described on page 885, Vol. 54. of the *American Machinist*.

The headstock, as shown in the accompanying illustration, is equipped with a single pulley for belt driving, but a motor drive can be furnished, if desired. The lathe swings 23 in. over the ways and 15¼ in. over the carriage. The minimum length of bed is 8 ft., and the distance between centers for this length of bed is 3½ feet.

The quick-change mechanism provides 45 changes of thread and feed and the geared head gives twelve changes of spindle speed. All gears are of alloy steel, heat treated and hardened. The regular equipment includes a compound rest, large and small faceplates, steady rest, chasing dial and wrenches.



Morris Geared-Head Lathe with Cabinet Legs

Kopf Cleaning Machine for Polishing Wheels

A machine, designed to eliminate many of the deficiencies in present methods for cleaning polishing wheels, is now being marketed by M. G. Kopf, 612 Schwind Bldg., Dayton, Ohio. This machine utilizes a jet of steam or steam and water for cleaning, instead of the usual method of turning off the accumulated abrasive by means of a steel tool or a piece of broken grinding wheel.

The turning operation has many disadvantages, among which may be

Kopf Cleaning Machine for Polishing Wheels

mentioned the removal of a considerable amount of cloth or felt each time the wheel is cleaned; the time required to properly clean a wheel; and the production of quantities of dust and lint in the polishing room.

The cleaning machine, as shown in the accompanying illustration, has a sheet-metal cylinder, attached to an ordinary polishing lathe and provided with a removable cover. A steam nozzle enters the cylinder at one side, and is mounted on a slide so that it can be brought to the proper position for cleaning, this location being ½ in. from the wheel.

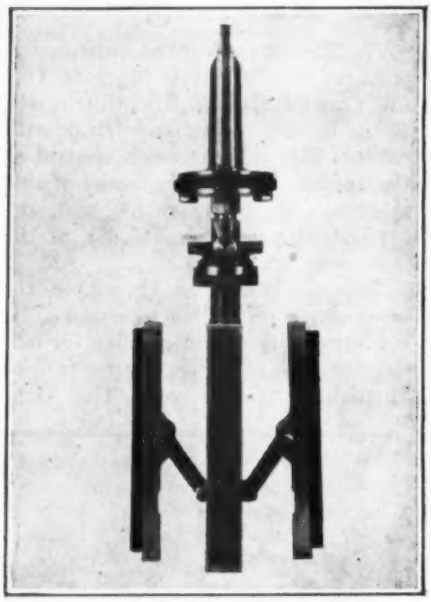
The wheel to be cleaned is placed on the spindle and run at 2,200 r.p.m. with the steam turned on. The abrasive and glue are heated by the steam and thrown off by centrifugal force, collecting at the bottom of the cylinder where a drain is provided. For leather-faced block, walrus hide, and sheepskin wheels, water is admitted through a connection above the steam nozzle.

It is claimed that this machine will clean wheels up to 4 in. wide and 20 in. in diameter, with no loss of material and no change in wheel shape. Wheels with formed contours used on special shapes of work can therefore be cleaned without the necessity of reshaping the wheel afterward.

Campbell Cylinder Hone

For burnishing internal combustion engine cylinders after they have been rebored or reground, the Campbell Auto Works, 232 N. El Dorado St., Stockton, Calif., has recently placed on the market an adjustable cylinder hone. The tool may also be used for refinishing cylinders that have been slightly scored, but not worn out of round or tapered. Under these conditions cylinders should be rebored before honing, as the hone will only smooth the surface and not correct out-of-roundness or taper.

The adjustment of the diameter of the hone is made by means of a



Campbell Cylinder Hone

knurled collar located below the driving spindle, and a range from 2¾ to 5 in. in diameter is provided. One spring controls the four expanding arms and it is said that changing the size does not affect the tension.

The stones are 6x⅝x⅜ in. in size and are mounted in aluminum holders. The universal joint is a thermoid coupling and the tool can be used either with a drill press or a portable electric drill.

Smith-Pearson Electric Lamp Lock

The lock for electric lamps shown in the accompanying illustration has recently been placed on the market by the Smith-Pearson Co., 10 Twenty-second Ave., Paterson, N. J. This lock consists of a ring that fits over the top of the socket, to which is attached a heavy wire loop as shown. The tip of the bulb is encased at the bottom of the loop and, when the loop and the ring are fastened together and sealed, it is

Smith-Pearson Electric Lamp Lock

claimed that the bulb cannot be removed without breaking the tip.

If the bulb burns out, the tip is broken and the bulb is unscrewed. The loop can then be pushed up through the ring so that the seals can be removed to expose the nuts, allowing the loop to be released from the ring. When the new bulb is in place, the nuts are again tightened and the seals are replaced.

Germans Increase Their Production

Throughout March the gradual increase in the volume of German production, which began in February, continued throughout February, Commercial Attaché Breed cables the Department of Commerce. However, there is considerable question as to the actual profits derived. The west German iron and steel industry reports an improvement in business for the first time in many months, although the industrials who signed the contracts with the Micum in the Ruhr are still said to be operating with large deficits.

News of the Week

Committees Named by President Hartness of Engineering Council

Low, Townley and Finney delegates to World Power meeting

Leading engineers, economists, educators and industrialists will direct the public service activities of the American Engineering Council, Ex-Governor James Hartness of Vermont, president of the Council, announced in making public the personnel of numerous committees and appointments of representatives to act with other national bodies here and abroad.

Gardner S. Williams of Ann Arbor, Mich., heads the Committee on Government Re-organization as Related to Engineering Matters, composed of Francis Blossom, L. B. Stillwell, and J. Parke Channing of New York, J. H. Finney of Washington, John Lyle Harrington of Kansas City, Mo., P. N. Moore of St. Louis, Max Toltz of St. Paul, and Hunter McDonald of Nashville.

Calvert Townley of New York, vice-president of the Westinghouse Electric & Manufacturing Co., is named chairman of the Public Affairs Committee, other members of which are L. P. Alford and F. B. Jewett of New York, Prof. D. C. Jackson of the Massachusetts Institute of Technology, and Fred J. Miller, member of the Pennsylvania Public Service Commission.

Dean Arthur M. Greene, Jr., of Princeton University heads the Committee on War Department Personnel. His associates are President S. W. Stratton of the Massachusetts Institute of Technology, Prof. C. F. Scott of Yale, Dean Dexter S. Kimball of Cornell, F. L. Hutchinson of New York, H. W. Eales of St. Louis, and W. G. Sheehan of Detroit.

WASTE IN INDUSTRY COMMITTEE

F. K. Copeland, a Chicago manufacturer, is chairman of the Committee on Elimination of Waste in Industry organized by Herbert Hoover. Dean Perley F. Walker of the University of Kansas and B. A. Parks of Grand Rapids, Mich., are the other members.

William McClellan, formerly dean of the Wharton School of the University of Pennsylvania, is chairman of the Federal Power Committee, the members of which are E. B. Katte of New York, C. G. Adsit of Atlanta, F. G. Baum of San Francisco, Erskine Ramsay of Birmingham, Ala., C. C. Thomas of Los Angeles, and J. H. Finney of Washington.

The Committee on Patents, which will recommend reforms in the U. S. Patent Office, consists of E. J. Prindle of New York, chairman; F. P. Fish of St. Louis, A. E. Lindau of Buffalo, F. E. Flanders of Springfield, Vt., E. W. Rice, Jr., of Schenectady, N. Y., Charles A. Terry of San Francisco, and William Schwanhausser of New York.

Max Toltz of St. Paul is chairman of the Committee on Contracts and Adjustments. Other members are Prof. Comfort A. Adams of Harvard, W. A. Darling, David R. Lyman, George R. Putnam and H. M. Southgate.

Calvert Townley and Fred R. Low of New York and John H. Finney of Washington have been appointed delegates to the World Power Conference in London. W. R. Ingalls, New York mining engineer and economist, is the Council's representative on the National Bureau of Economic Research. Rudolph P. Miller of New York was reappointed to the National Board for Jurisdictional Awards.

Dr. Swasey Presented Fritz Medal

The John Fritz Gold Medal was presented to Dr. Ambrose Swasey of the Warner & Swasey Co., Cleveland, Ohio, at a meeting held at the Engineering Societies Building 29 West 39th St., New York City, Wednesday, April 23. Addresses were made by Charles F. Rand, chairman of the Board of Award, Dr. William Wallace Campbell, president of the University of California, General William Crozier, formerly Chief of Ordnance, and Dr. John R. Freeman, past president, the American Society of Civil Engineers and the American Society of Mechanical Engineers.

Dr. Swasey was awarded the medal for achievements as a designer and manufacturer of instrument and machines of precision, as a builder of great telescopes, a benefactor of education and the founder of the Engineering Foundation.

Chicago Machinery Club Elects Officers

The seventh annual meeting and election of officers for the Machinery Club of Chicago for the ensuing year was held on April 15, and the new members elected to the Board of Governors were:

H. W. Mons of the Hill-Clark Co. and Clarence James of the Leland-Gifford Co.

The following members were elected as officers:

President, H. S. White, the Cleveland Twist Drill Co.; vice-president, F. L. Kohlhase, the National Stamping & Electric Works; treasurer, H. J. Reeve, the Reeve-Fritts Co.; secretary, R. W. Barry, Drying System, Inc.

Following is a complete list of the Board of Governors:

H. S. White, the Cleveland Twist Drill Co., F. L. Kohlhase, the National Stamping & Electric Works, H. J. Reeve, the Reeve-Fritts Co., R. W. Barry, Drying Systems, Inc., H. Barrett, the Barrett-Christie Co., W. L. Slack, the Torchweld Equipment Co., C. H. Roth, Roth Brothers, E. P. Welles, the Chas. H. Besly & Co., C. H. James, the Leland-Gifford Co., H. W. Mons, the Hill-Clark Co., H. F. Kempe, the H. F. Kempe Co., and S. A. Ellicson, the Chicago Pulley & Shafting Co.

Ohio Foremen Will Hold Convention

The first annual convention of the Ohio Federation of Foremen's Clubs will be held in Dayton, Ohio, on May 14, and plans have been completed whereby an interesting program will be presented. Efforts are being made to have a large number of foremen present at the meetings and factories in all parts of the state have joined in sending representatives, one factory sending four foremen and an executive, while others have signified their intention of having good representation.

The major portion of the program will be held in the new auditorium of the National Cash Register Co., Dayton. C. E. Burnett, president of the Dayton Chamber of Commerce, will deliver the speech of welcome and short talks will be given by the following: T. B. Fordham, president of the Federation and superintendent of the Delco-Light Co., Dayton; J. C. Haswell, president of the Dayton Malleable Iron Co.; D. J. McDonald, Columbus, Ohio; and William Hartman, factory superintendent of the National Cash Register Co.

The afternoon will be spent in a trip to McCook's Field where the United States Experimental Station is situated.

Rules for Handling Gas Cylinders

"Rules for the Safe Handling of Gas Cylinders," published on page 424, Vol. 60, March 20 of the *American Machinist* has been reprinted on placards suitable for posting on bulletin boards or the walls of welding shops and copies may be obtained by request to C. T. Price, secretary and treasurer of the Gas Products Association, 140 S. Dearborn St., Chicago, Ill.

Insull Outlines Super-Power Programs

Samuel Insull, president of the Commonwealth Edison Co. of Chicago, addressing members of the Philadelphia Bond Club at the Bellevue-Stratford Hotel in Philadelphia, declared that the super-power program would be of the greatest benefit to electricity users. The harnessing together of lines carrying current generated in various sections will increase the capacity factor of plants, Mr. Insull said, but warned those attending the meeting not to have too great illusions about the super-power movement. Generation of electricity by water-power, he said, can be profitable if the hydro-electric plant is close to consumers.

"There are limitations as to how far current can be carried," he said. "Just how far I would not hazard a guess. There are many persons who go rather wild on the question of super-power, but, as I see it, this part of the country will depend upon power generated by steam plants for years to come, with the exception of the northern portion of New England.

"The talk of energy generation close to the mines is all right, but unfortunately to produce electricity economically in a steam plant vast amounts of good water is not always available close to mines."

Mr. Insull said he did not believe more than 60 per cent of the ultimate industrial power load capacity has yet been reached, pointing out that numbers of homes, farms, etc., are still without electrical energy and that the large railroad systems of the country have not yet been electrified. He added it would be possible materially to increase the amount of power furnished for every dollar invested in the business, citing the situation in California, where the application of super-power development has resulted in the capacity factor of electric power plants of the State reaching 46 per cent, as compared with about 15 per cent in states where there is little or no connection of power units.

New England Meeting of Taylor Society

An interesting meeting of the Taylor Society is scheduled for April 24, 25 and 26 at Cambridge, Mass., under the auspices of the engineering societies in that section of the country. The first day's sessions will be held at Harvard University, the second day's at the Massachusetts Institute of Technology and the Saturday morning session at the Boston University, College of Administration. Among the speakers expected to be present are: Henry S. Dennison, president of the Dennison Manufacturing Co., Framingham, Mass.; Mrs. Jane C. Williams, director of personnel, the Plimpton Press, Norwood, Mass.; Joseph H. Barber, staff assistant to the president, the Walworth Manufacturing Co., Boston Mass.; H. S. Person, managing director of the Taylor Society, New York City; and Norman T. Thomas, superintendent of the Jackson Mills of Nashua Manufacturing Co., Nashua, N. H. There are many discussions also listed for the meetings.

Moline Meeting of the A.S.S.T

The plans for the spring sectional meeting of the American Society for Steel Treating to be held under the auspices of the Tri-City Chapter of the Society on May 22 and 23 at Moline, Ill., are well under way. The headquarters will be at the LeClaire hotel.

The executive committee consists of H. B. Bornstein, chairman; C. H. Burgston, R. Henry, H. O. Koehler, C. A. Schoessel, C. H. Lage, J. F. Lardner, C. U. Scott, H. Brown and A. H. Putnam.

Following registration on Thursday morning, there will be a technical session followed by a luncheon. The second technical session will be held in the afternoon and papers will be presented by Dr. Anson Hayes, Iowa State College; C. B. Swander, metallurgist the Wagner Electric Co.; R. G. Guthrie, metallurgist, the Peoples Gas Light & Coke Co., Chicago; and J. H. Nelson, metallurgist, the Wyman Gordon Co., Worcester, Mass.

In the evening a banquet will be held at which time Dr. George K. Burgess, president of the A.S.S.T., will be the principal speaker.

Friday will be devoted to plant visitation and amusements including golf and other sports.

Preparing Program for Management Week

Management Week, under the auspices of the Management Division of the American Society of Mechanical Engineers will be held beginning on Oct. 20, 1924. The technical program will be participated in by the Society of Industrial Engineers, the Taylor Society, the American Management Association, the National Association of Cost Accountants, and the Management Division of the American Society of Mechanical Engineer. The A.S.M.E. has appointed Sterling H. Bunnell, a consulting engineer of New York as its representative on the arrangements committee.

WONDER IF A SENATOR EVER TRIED TO HIRE ONE

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CHEAP LABOR SEE?
U.S SENATE
GOOD! WE NEED SOME GOOD HARD WORKING STREET CLEANERS, SOME INEXPENSIVE HOD CARRIERS AND FARM HANDS AND—
NO SABEY
WELL THEN HOW ABOUT SHOVELING OR CLEANING OUT THE CELLAR OR CUTTING THE GRASS OR BEING A SECTION HAND
NO SABEY
HOW MUCH DO YOU WANT FOR ALL THIS TALENT?
SEVEN DOL' A DAY
Ding.

Ding in the N. Y. Herald-Tribune.

Notes on Washington Activities

By Paul Wooton

Conduct of the Federal Government's reclamation activities again is in the hands of an engineer. D. W. Davis, the business man chosen by Secretary Work as Commissioner of Reclamation has been removed from that position and Dr. Elwood Mead, professor of Rural Institutions, University of California, has been selected as his successor. Mr. Davis will continue with the Bureau. He has been placed in charge of a newly created Division of Finance. This Division is being set up at the suggestion of the advisory committee on reclamation. It will be the Bureau's collection and credit agency. The advisory committee is of the opinion that project managers should be relieved of the burden imposed upon them in connection with the handling of accounting matters. It will be the duty of Mr. Davis in his new capacity to recover as much as possible from over-due accounts and to devise means whereby such accounts can be obviated in the future.

When A. P. Davis, the former Director of the Reclamation Service, was advised of the appointment of Dr. Mead he said no better selection could have been made. His long experience, his administrative ability, his resource and his ability to be constructive, the former director declared, makes the choice a particularly happy one. Mr. Davis expressed the opinion that he would be a great asset to the water users and to the Federal Government.

It is understood that Dr. Mead is to receive a salary of $11,000. No salary in excess of $7,500 has been paid heretofore to the head of the Reclamation Bureau. As soon as the advisory committee completes its work, which will be before the middle of April, it is understood that Dr. Mead expects to leave on a visit to a number of the projects.

Railroad Earnings Are Over Six per Cent

Class One railroads representing a total mileage of 235,901 miles, earned at an annual rate of return of 6.28 per cent on their tentative valuation in February, freight traffic for that month having been the greatest for any February on record, according to reports for the month compiled by the Bureau of Railway Economics from returns filed with the Interstate Commerce Commission.

In dollars this represented a net operating income of $71,191,600. The same roads in February last year earned a net operating income of $39,274,900, which was at the annual rate of return of 3.76 per cent. In January, 1924, the net operating income was $51,281,000 or 4.38 per cent.

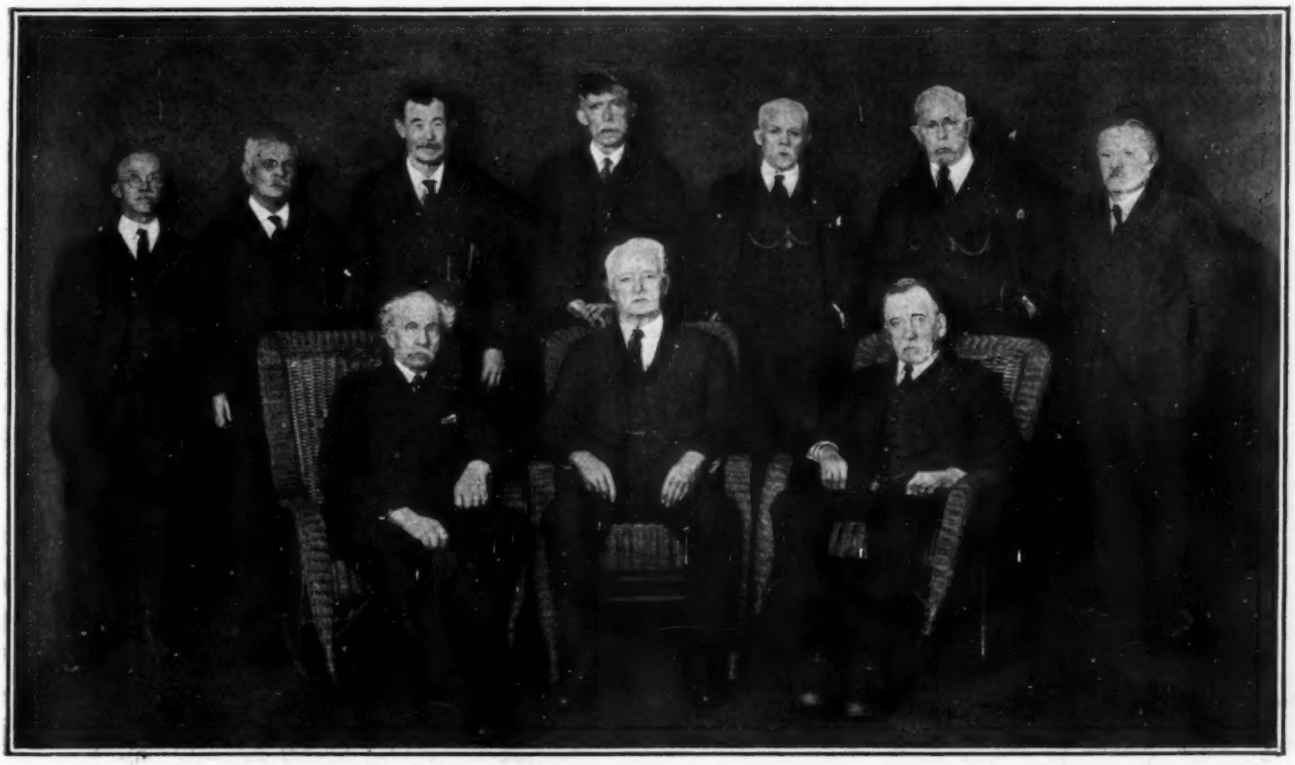
The net operating income is what is left after the payment of operating expenses, taxes and equipment rentals, but before interest and other fixed charges are paid.

Operating revenues of the Class One roads in February amounted to $478,914,250, an increase of $31,965,380 or 7.2 per cent over the same month last year. Operating expenses totaled $374,699,900, a decrease of $1,306,700 or three-tenths of one per cent under those for the same month last year.

For the first two months this year Class One railroads had a net operating income representing an annual rate of return of 5.32 per cent on their tentative valuation.

Men Who Have Devoted Their Lives to Firearms Industry

At a recent gathering of the older employees of the Colt's Patent Firearms Manufacturing Co. of Hartford, Conn., a photograph was made of ten men who have been continuously in the service of the company for more than half a century. Six others, not present at the gathering, are entitled to be included in the group, making sixteen men whose combined service aggregates 860 years. The longest single record—sixty-six years—is held by Edwin H. Williams, who entered the employ of the company in November, 1857, and has been actively engaged in the making of firearms through three wars in which the United States has been involved.



Front row, left-right; — George C. Green, Edwin H. Williams, David J. Jordan
Rear row:—William E. Cluff, Edwin M. Stevens, Richard Broomhall, Michael J. Quinn, James Shortell, William J. Morrow, David J. Ahearn.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance*, New York

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THE highly sensitized instruments that are called "the markets" are much like the seismograph. They register the slightest tremor in the business structure no matter where it occurs. Last week several disturbances were recorded. The indiscreet letter of the Japanese Ambassador and the retaliatory action of the Senate in voting to exclude all Japanese immigrants from the United States revived talk of the "Yellow Peril" and caused a sharp decline in the Japanese yet as well as in the bonds recently floated here.

The unconditional acceptance of the Dawes plan by France, Italy, and Great Britain and its acceptance "in principle" as a basis of discussion by Germany were followed by a sharp advance in francs and sterling.

But somewhat paradoxically America now views askance the prospect of Europe's economic recovery in the fear that if her currencies and exchange are stabilized she will flood us with cheaply made goods against which even the present tariff will not protect us.

And coming nearer home, the row between the Senate and President Coolidge has increased the political tension here and provided the pessimists and the bears with another lever that they have not been slow to use in unsettling confidence.

It is persistently asserted that the demand for new automobiles is very disappointing, that the manufacturers are curtailing production, and that some factories are closed down entirely; that the cotton mills in New England are running at a loss when they run at all and that the woolen industry is working at less than 75 per cent of capacity; that fewer plans for new buildings are being filed; that there has been a sudden lull in the demand for steel, lumber and building material; that car loadings are smaller and that the comparatively low prices at which bituminous coal is pressed for sale indicate a slackening of industrial activity throughout the nation.

The business hesitancy induced by this sort of talk has become so noticeable that the President has felt himself called upon to issue a semi-official statement from the White House in which it is asserted that business is "fundamentally healthy" and that "the stage is set more for a boom than a depression." But it is admitted that "the textile industry in New England and the coal industry are seen by the administration as the two bad spots in the national economic picture."

It is much to be feared that the feeling of doubt which seems so pervasive will be intensified by the official recognition thus given it. Therefore it is well to remember that there can be nothing like panic unless there has been previous distension and that the spirit of caution in which business has been conducted for more than a year has led merchants so to reduce their stocks and their obligations that there can be no general liquidation because there is nothing to liquidate when warehouse shelves are empty.

What's Doing in Industry

Several large sales of machine tools and some good orders for exports were received during the past week by dealers in the East, bringing the general machinery and machine tool business up to a better average than has been noted during the past five weeks. The outlook for May is neither encouraging nor discouraging. Dealers and manufacturers do not anticipate any heavy or exceptional buying and orders, except the usual run of replacement orders, are not in sight.

Steel prices steadied after a slight drop, but predictions are that lower figures will be in evidence within the next thirty days. Production was also slightly off from the record figures of the past month.

Intensive sales campaigns staged by the automobile companies are having some effect and cars are moving a little better than during March. Whether warehouses will be cleared sufficiently to increase production is problematical.

Bear tracks are still in evidence in the stock market, although there was a stiffening in many of the active issues during the week. Trading, however, was listless and interest, except that shown by the professional speculators, was lacking.

Exporting remains exceptionally good for this time of the year and is far ahead of the first four months of last year.

General business has been steady and satisfactory, according to economists, with nothing in the offing to upset this condition.

By auto suggestion we can, of course, work ourselves into a state of melancholia, but the facts do not justify it, and it seems to be a time when we should take counsel of hope rather than of fear. The chief reason for the hypochondria that now prevails is the persistence with which the avoidance of inflation has been preached. Its dangers have been so vividly pictured that hand to mouth buying has become a national policy, and the result is that the farmers and manufacturers who are at the base of the economic structure have been left with the bag to hold. Their operations cannot be conducted on a hand to mouth basis for they must plan their production for nearly a year ahead. It may be that the present lack of confidence in the future will lead them to restrict the output for which they are now preparing. The wheat acreage has already been reduced, it is claimed.

The stock market has been dull and hypersensitive to bear attacks. Some close observers insist that its condition reflects the constant exchange of taxable for tax exempt securities. The promptitude with which the $45,000,000 bonus bonds recently issued by the state of New York were absorbed is cited as example. There was no reserve of uninvested capital that could be drawn upon to pay for these bonds. It had to be obtained and probably was obtained from the sale of taxable stocks and bonds. So it is with the other tax exempt securities that are constantly being brought out.

It is, however, unlikely that this displacement of security holdings will have much effect as long as credit continues to be in abundant supply.

Thus far there is no indication of any change in this respect. The weekly statement of the Federal Reserve banks shows an increase of 1.3 per cent in the reserve ratio, which now stands at 80.6 a decrease of $15,000,000 in circulation and a reduction of $83,000,000 in earning assets. These figures cannot be construed to mean anything but easy money. Our foreign trade statement for March shows that merchandise exports exceeded imports by $22,000,000 and that of gold and silver we imported $31,000,000 more than we exported. These figures prove that insofar as our international trade is concerned we are on a strictly cash basis and that as long as we continue to sell more than we buy the world is somehow able to ship us gold. This is a fact that should give the pessimists pause.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Detroit

A prevailing feeling that the immediate future will clarify the atmosphere which during the past few weeks has cast a haze about the automotive industry has featured the past week in the machine tool field in Detroit.

From well-defined rumors afloat which seem to have some solid foundation, it appears that two of the leading automobile concerns are preparing announcements of unusual importance. Each will exert more than passing effect upon the machinery line than any previous one in 1924, it is asserted by those who claim to be in a position to know.

Many inquiries from plants doing but a seasonal business during the summer and fall are being brought to the attention of local leaders in the machine tool line, while replacements in the automobile and their accessory lines are standing up well.

Attesting to the more hopeful outlook the Ford Motor Co. has announced figures for production and sales during March which break all previous marks.

Employment has dropped slightly, but not sufficient to indicate any let-up in industry. Railroads report heavy shipments, while construction figures in this vicinity are mounting to new high records.

Canada

While special interests in Canada such as the car companies, automobile manufacturers, electrical manufacturers, etc., are getting, and looking forward to good business, the foundries and machine shops are complaining of a dearth of new business.

Industry in the Dominion is principally concerned at present with the federal government budget announcements involving a taxation relief of twenty-four million dollars, a reduction in the public debt of thirty millions, and a number of tariff reductions designed to reduce the cost of implements of production and assist farming, mining, lumbering and other industries. The industry principally affected by the tariff cuts is the manufacture of agricultural implements. It is frankly admitted that the reductions open the way to increased competition from United States makers. Farming implements placed on the free list are reapers and cultivators, while the present general tariff rate of fifteen per cent on ploughs, threshing machines and other implements has been reduced to ten per cent.

The motor vehicle export trade continues its rapid expansion. Exports of automobiles and parts during the twelve months ended February were valued at $36,571,000, an increase over the previous twelve month period of nearly nine million dollars, of which about four million dollars was in freight automobiles. Heavy shipments are continuing to Australia, New Zealand, South Africa, the United Kingdom and the British East Indies.

Sawmills are due to start operations shortly. Road-building and railway construction work are beginning to provide employment for a considerable amount of labor. The weekly car loadings since the first of the year have increased 13.3 per cent compared with the corresponding period last year.

The Canadian National Railways and the Wabash are now in the market for equipment for locomotive shops to be erected in St. Thomas, Ontario. The Canadian Pacific Railway is preparing lists for replacements at various shops throughout the country. The Canadian Locomotive Co., Kingston, has received an order from the Canadian Pacific Railway to build ten tenders or tanks, similar to the Mikado types built last year for the same railroad company.

Milwaukee

While there has been somewhat of a slackening of inquiry from buyers of metalworking equipment, especially in the automobile producing centers, makers as well as dealers report that sales in April have been pretty well sustained. So far as the manufacturers are concerned, however, deliveries are running ahead of new bookings, and unfilled business as April comes to a close is considerably smaller than at the end of any of the last twelve months.

Retrenchment by automobile manufacturers has become pronounced, and this is adversely affecting the parts and accessories producers, an important factor in the Milwaukee metalworking industry. The call for tools has slowly shaken itself down to a purely replacement proposition, and these needs represent but a small volume.

The city of Milwaukee will not build the proposed $250,000 central repair plant for servicing all municipal equipment, machinery and vehicles, as the electors voted down a bond issue in this sum.

Purchases by railroads in this market have been far below expectations, due mainly to the financial stringency of one of the principal lines maintaining its largest shop in Milwaukee.

The agricultural machinery industry continues to do very little buying, as the major part of existing capacity still lies idle and there is no immediate prospect of sufficient improvement in the demand to employ the remaining available facilities.

The manufacturers of woodworking machinery are still well occupied with business, but fresh orders are coming forward slowly and hesitatingly. This refers particularly to concerns whose activities are principally allied with the automobile trade, which has been a bulwark in woodworking equipment business for two years or longer.

New York

Buying of machinery and machine tools continued during the past week beyond the outlook of the first part of the month and the past two weeks will bring up the average for the month to better than March, but hardly up to the January or February business of this year. Exceptionally large buying and closing on lists have been responsible for this week's sales, so the volume cannot be taken as a criterion and dealers in the New York district do not hold that business will be maintained at the same level.

Railroads have been buying rolling stock and this in turn sends business to Eastern dealers. Despite the let-up in automobile production, accessories and parts makers are still customers to a limited degree. The big electric companies are buying tools from time to time and the indications are for a continuation of this buying well into the fall. A $300,000 sale of planers in the Rochester district has been reported but not confirmed.

Exporting has been very good and the first four months of this year should show as great a return as the first six months of last year or even better, according to exporters.

Used tools are finding a ready market with some of the buying coming from the South and other purchases being recorded from traction companies in the East.

Indianapolis

While there has been no marked expansion in either machinery or tool trade here during the last week or two, business continues satisfactory as compared with that of the same period last year. No one industry appears to stand out as a prospective buyer either for tools or machinery. The last few weeks has seen a slump in the demand for milling machinery, according to companies located here.

The automobile situation is subnormal after a rather exceptional start immediately after the mid-winter shows. Lack of automobile sales is re-acting somewhat on the manufacture of automobile accessories, but to a

limited degree. Some of the accessory plants, especially those that make appurtenances for cheaper cars, are very busy and their demands show some increase.

E. C. Atkins & Co., recently completed two monster saws for a lumber company in Oregon. The saws are more than 100 inches in diameter and are said to be the largest ever made. Officials of the company say their business is improving somewhat and with the arrival of summer and the building season, they expect more business.

Southern District

Machine tool business in the Southern district seems to have slowed up a little as compared with the volume during the first quarter, running about on a par during April with the same month last year. Most of the larger dealers and manufacturers, however, are confident the lull is but temporary, and are looking for a better volume in May.

Inquiries from the railroads have fallen off since the first of the month, and there has been a resultant decline in heavier equipment sales. But this is not likely to last for long, as the larger railroads in the South are doing more construction this year than they have done in the past decade. Principally is this true of new shop construction and additional shop facilities, several million dollars worth of this sort of work now being in progress in the various Southern states.

It is interesting to note that so far as the South is concerned, the first quarter of the year witnessed the greatest industrial activity in the history of the district in the construction of new plants and additional facilities for existing plants.

Machine tool sales to smaller shops are fairly active, while garages and service stations lead the field of buyers, with the possible exception of the railroads.

A considerable volume of business is reported in second hand and rebuilt equipment.

Cost of Living Is Lower

The cost of living in the United States on March 15, 1924, had decreased four-tenths of one per cent from the level of Feb. 15, 1924, as is shown by a comprehensive survey just completed by the National Industrial Conference Board. The most important change within the month from February to March was a decrease of 2 per cent in food prices. Since November, 1923, the most important changes noted were decreases of 4.6 per cent in average food prices and slightly more than 3 per cent for fuel. Average rents increased nearly 3 per cent in the four months. The combined decrease for all items, in the period between November and March, was 1.3 per cent. Between July, 1920, when the peak of the rise in the cost of living since 1914 was reached, and March, 1924, the cost of living decreased 20.2 per cent. The increase since July, 1914, was 63.2 per cent.

Business Items

The Kearney & Trecker Corp. and the Landis Machine Co. will combine with the Warner & Swasey Co. in the present quarters at 618-622 W. Washington Street, Chicago.

The Hendey Machine Co. the Barber-Colman Co., and the Leland-Gifford Co. will occupy the quarters vacated by Kearney & Trecker Corp., 631 W. Washington Blvd., Chicago.

The Pratt & Whitney Co., has announced that on and after May 1 its stock of small tools and gages for the New York territory will be carried at the main office, Trinity Building, 111 Broadway, thirteenth floor, instead of at the warehouse, 326 Hudson St., New York.

A new machine shop will be built by the Carnegie Steel Co. at its Homestead plant.

The Union Screw & Manufacturing Co., Pittsburgh, has succeeded the Wickam Screw Works, Pittsburgh.

Samuel Harris & Co., Chicago, celebrated their fiftieth anniversary recently.

With a capitalization of $1,000,000 the Alpha Specialties, Ltd., has been incorporated in Canada with headquarters in Montreal, to manufacture accessories and parts of locomotives, engines, boats and vessels of all kinds. The principal incorporators are Omer Danis, Emile Morin and Lorenzo Lachance, all of Montreal.

The Athens Plow Co., of Athens, Tenn., has announced plans for the construction of a new foundry plant this spring, with a daily output of about four tons of castings. Equipment for the machine shop has been purchased from the Seeger Machine Tool Co., of Atlanta, Ga.

The new foundry and machine shops being constructed at Jacksonville, Fla., by the Florida Machine Works, on West Church St., will be occupied some time in the late spring, the machine shop plant having been already completed, and being the largest machine shop in Florida. The plant will be devoted largely to railroad work.

The Superior Welding & Machinery Co., of Atlanta, has leased larger quarters at 709 Marietta St., and will shortly occupy the new plant.

The acquisition of the Hayes Motor Truck Co., St. Johns, the Albion Bolt Co., Albion, and the Morrison Metal Stampings Co., Jackson, by the Hayes Wheel Co., of Jackson, Mich., has been approved by the latter's stockholders.

The Metal Trades Employers' Association of British Columbia, comprising engineering works, foundries, machine shops and metal working establishments held its annual meeting in Vancouver recently. Among other business transacted was a decision by the metal trades employers to re-organize their association and affiliate with the Canadian Manufacturers Association, as a trade section, to be known as the Metal Trades Employers' Section.

The Ferro Products Co., Brooklyn, N. Y., has been incorporated under the new name of the Ferro-Co Corp. A. D. Mellor is president and Everett P. Larkin is vice-president and treasurer of the new corporation.

Obituaries

JAMES DUNLOP, founder and director of the Canadian Tube & Steel Products, Ltd., died recently at his home in Montreal following an illness of three months. He was 69 years of age, and had been connected with the iron and steel industry for the past 45 years.

HARRY C. MAY, Indianapolis, former general manager of the Monon and C. I. & W. railroads in the period of governmental control, and for a number of years a prominent railroad man of the Central West, died recently. For the last year he had served as president of the Midwest Engine Corporation, of Indianapolis.

ROBERT C. WHITE, president of the Kleyensteuber-White Foundry Co., of Birmingham, Ala., died recently at the home of his daughter in Dallas, Tex., at the age of 72 years. Mr. White was formerly superintendent for several years for the Birmingham Machine & Foundry Co., later organizing the Birmingham Rail & Locomotive Co. He was also one of the organizers in 1906 of the Beggs Pipe & Foundry Co., and later established the company of which he was president at the time of his death.

JUDSON CLEMENTS WALRAVEN, a member of the firm of the Walraven Machinery Co., Atlanta, Ga., distributors in the Southern territory for many years of machinery, machine tools, and mill supplies, died recently at his home in Atlanta at the age of 41 years. His son, J. C. Walraven, Jr., and two brothers, Francis C. Walraven and J. R. Walraven, also members of the firm, survive. Mr. Walraven has been identified with machine tool distribution in the South for a number of years.

Personals

HOWARD K. JACKSON has been made Western representative of the Brown & Sharpe Manufacturing Co., Providence, R. I. He succeeds GEORGE M. PEARSE, who has resigned. His headquarters will be in Chicago.

W. H. WILLIAMSON, formerly superintendent of the Hartford Machine Screw Co., Hartford, Conn., will represent the cutting oil department of the Sinclair Refining Co. in Connecticut, Vermont and western Massachusetts, in conjunction with A. M. STILLMAN.

CARL LINDEN has been appointed Eastern sales manager for the Cincinnati Planer Co. and the Acme Machine Co., Cincinnati. He will act in conjunction with Henry Prentiss & Co. and the W. E. Shipley Machinery Co., Philadelphia.

HARRY S. MCCLELLAN has become affiliated with the Maxwell Motors Corp. He was formerly superintendent of plant No. 1 of the Buick Motor Co. of Flint.

FENN M. HOLDEN has joined the advisory staff of the engineering and research division of General Motors Corp. Mr. Holden was formerly connected with the engineering department of the Peerless Motor Car Co.

WILLIAM DWIGHT LOOMIS, formerly with the Cadillac Motor Car Co., has been appointed manager of the export department of the Gray Motor Corp.

CLARENCE S. ARMS has resigned as superintendent of the Wickwire-Spencer Corp. plant in Palmer, Mass., to join the Wheeldon Wire Co. at West Brookfield, Mass. He is succeeded at Wickwire-Spencer by CARL KING of Monson, Mass., a graduate of Massachusetts Institute of Technology in 1904 and for some years with the American Steel & Wire Co. in Worcester and New Haven.

F. F. CHANDLER, chief engineer of the Ross Gear & Tool Co., Lafayette, Ind., chairman of the Indiana section of the Society of Automotive Engineers, and MAJOR R. E. CARLSON, of the United States Bureau of Standards, Washington, spoke at the April meeting of the Indiana section of the Society of Automotive Engineers.

W. D. ROCKWELL, formerly sales manager for the AC Spark Plug Co., Flint, Mich., has been appointed director of sales for the Parsons Manufacturing Co., Detroit, Mich. Mr. Rockwell was formerly with the Universal Machine Co., Bowling Green, Ohio, and the Adams Axle Co., Findlay, Ohio.

G. V. ROTTWEILER, formerly superintendent of the Studebaker Corp., South Bend, Ind., has joined the organization of the Niagara Motors Corp., Dunkirk, N. Y., as chief engineer.

J. ARTHUR DEAKIN will represent the Universal Boring Machine Co., Hudson, Mass., in the New York territory and not the Universal Milling Machine Co. as was previously announced. His headquarters will be at 150 Nassau St., New York City.

GEORGE D. WILSON has been elected general manager of the C. R. Wilson Body Co., Detroit, Mich.

K. T. KELLER, formerly manager of production of the Chevrolet Motor Co., has been made general manager of General Motors of Canada, Ltd., with headquarters at Oshawa, Ontario.

C. A. PAQUETTE, of Cincinnati, had resigned as chief engineer of the Big Four railway system to become the head of a construction company in Cleveland.

CHARLES C. CROSS, who recently became associated with the Detroit plant of the Fisher Body Corp., has been transferred to Lansing and will manage the newly completed plant in that city.

D. S. WOOD, Philadelphia sales manager of the Niles-Bement-Pond Co., New York, has been transferred to the Chicago office as sales manager, succeeding SAMUEL EASTMAN who has been granted a leave of absence of several months.

H. A. MEYERS has joined the sales force of the Dale Machinery Co., Chicago. He was formerly with the Millholland Machine Co., Indianapolis, Ind.

JOHN UTZ has joined the sales force of the Stocker-Rumley-Wachs Co., Chicago. He was formerly with the Federal Machinery Sales Co., Chicago.

JOHN H. WYNNE has been made manager of the Lima Locomotive Works, Lima, Ohio. He has formerly been connected with the General Equipment Co. and the American Locomotive Co.

ARTHUR EARL has been appointed manager of the Canadian Acme Road Machinery Co., Ltd., a new company that is being organized by interests identified with the Acme Road Machinery Co. of Frankfort, N. Y., and Salem, N. Y. Mr. Earl's headquarters will be in Montreal.

E. M. ZEHNDER, president of the Scranton Bolt & Nut Co., Scranton, Pa., has been elected vice-president of the Railway Business Association to succeed the late STEPHEN C. MASON.

WILLIS C. LINCOLN has been appointed Western sales manager of the Electric Service Supplies Co. with headquarters in Chicago.

W. H. PHILLIPS has succeeded GEORGE OSTENDORF in the northern Ohio district of the Hilo Varnish Corp., Brooklyn, N. Y. His headquarters will be in Cleveland.

Penn State Will Have Short Industrial Course

Plant executives and engineers will be interested in a special two weeks course in industrial organization and management to be offered by the Pennsylvania State College, June 16 to 28 inclusive, given under the supervision of the Department of Industrial Engineering. This will be the ninth season for offering such instruction at Penn State. The results obtained in the past by Prof. Keller and others in the Industrial Engineering department are widely known among industries throughout the East.

C. & O. Places Large Equipment Order

William J. Harahan, president of the Chesapeake & Ohio Railroad, announced that the company had ordered $28,000,000 worth of equipment, the largest single order ever placed by the road.

The new equipment of the Chesapeake & Ohio will include 5,500 hopper cars, 2,000 automobile box cars, 600 ballast cars, 120 cabooses, fifteen express cars and 100 locomotives. More than 100,000 tons of steel are said to be involved in the order.

A Philadelphia report said the Pennsylvania was considering the construction of 250 locomotives in its own shops. Representatives of the railroad would not confirm the report but said the company had ordered 100 locomotives since Jan. 1. Of these, they said, fifty were being built in the road's own shops.

Announcement was also made that the Pacific Electric Railway Co., controlled by the Southern Pacific Co., will construct in its own shops five direct current 600-1,200 volt electric locomotives.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Industrial Machinery. Rio de Janeiro, Brazil. Purchase and agency. Reference No. 9823.

Machine tools. Horta, Azores. Purchase. Reference No. 9829.

Pneumatic tools. Cologne, Germany. Purchase. Reference No. 9866.

Machine tools. Katowice, Poland. Purchase. Reference No. 9820.

Woodworking, metalworking and plumbers' tools. Alexandria, Egypt. Agency. Reference No. 9872.

Forthcoming Meetings

American Gear Manufacturers Association. Spring Meeting. April 28, 29 and 30, 1924. Lafayette Hotel, Buffalo, N. Y. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

Society of Industrial Engineers. Eleventh annual convention. Buffalo, N. Y. April 30, May 1 and 2. Headquarters, 608 S. Dearborn St., Chicago, George C. Dent, executive secretary.

American Society of Mechanical Engineers. Spring meeting. Cleveland, Ohio. May 26, 27, 28 and 29. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

Southern Supply & Machinery Dealers Association, National Supply & Machinery Dealers Association, and American Supply & Machinery Manufacturers Association. Triple convention, May 19, 20 and 21, 1924, Hotel Cleveland, Cleveland, Ohio. F. D. Mitchell, secretary-treasurer, 1819 Broadway, New York City.

National Association of Purchasing Agents. Annual Convention, Mechanics Hall, Boston, May 20, 21, 22 and 23. W. L. Chandler, secretary, 19 Park Place, New York City.

Foreign Trade Council. Eleventh annual convention at Boston, June 4, 5 and 6. O. K. Davis, India House, Hanover Square, New York City, secretary.

The General Committee of Division V, Mechanical of the American Railway Association. Convention and exhibits. Atlantic City, June 11-18, 1924. V. R. Hawthorne, secretary, 431 S. Dearborn St., Chicago, Ill.

Railway Supply Manufacturers Association. Exhibit. Atlantic City, June 11-18, 1924.

American Society for Testing Materials. Twenty-seventh annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J. Week of June 23. C. L. Warwick, secretary-treasurer 1315 Spruce St. Philadelphia, Pa.

American Society for Steel Treating. Sixth Convention, Boston, Mass., Sept. 22, 23, 24, 25 and 26. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Twenty-eighth annual convention. Milwaukee, Wis. Week of Oct. 13, 1924.

Management Week. Under the auspices of the American Society of Mechanical Engineers. Week of Oct. 20, 1924. New York City.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—No. 2 foundry pig iron quoted at $23 per ton, f.o.b. Birmingham, with no tendency to go lower. Iron buying mostly in small lots; production slowing down; output in excess of demand. Steel mill operations declining rapidly. Average price of steel shapes, plates and bars, $2.40 per 100 lb. at Pittsburgh mill. As low as $2.20 on plates, $2.25 on shapes and $2.30 per 100 lb. on bars has been quoted in some instances where large quantities were involved. Bulk of current steel demand, however, is confined to small tonnages. Tin plate market active; mill shipments large.

Non-ferrous Metals—Copper firm at present level; inquiries plentiful. New York market advanced 2c. per lb. on tin and declined ¼c. on lead and zinc and ⅛c. on antimony since April 11. Zinc and antimony markets dull; recent decline in lead about checked.

(All prices as of Apr. 18.)

IRON AND STEEL

PIG IRON—Per gross ton—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$25.05
Northern Basic	24.00
Southern Ohio No. 2	24.00
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.00
BIRMINGHAM	
No. 2 Foundry	23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.25
Virginia No. 2	28.17
Basic	24.00
Grey Forge	24.00
CHICAGO	
No. 2 Foundry local	24.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	27.00
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	25.77
Basic	25.77
Bessemer	26.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.50@4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh	New York	Cleveland	Chicago
No. 10	$2.85@3.00	4.34	3.75	4.00
No. 12	2.95@3.10	4.39	3.80	4.05
No. 14	3.05@3.20	4.44	3.85	4.10
No. 16	3.25@3.40	4.54	3.95	4.20
Black				
Nos. 17 and 21	3.70	4.65	4.45	4.55
Nos. 22 and 24	3.75	4.70	4.50	4.55
Nos. 25 and 26	3.80	4.75	4.55	4.60
No. 28	3.85	4.85	4.65	4.70
Galvanized				
Nos. 10 and 11	3.90@4.00	4.90	4.70	4.60
Nos. 12 and 14	4.00@5.10	5.00	4.80	4.70
Nos. 17 and 21	4.30@4.40	5.30	5.10	5.00
Nos. 22 and 24	4.45@4.55	5.45	5.25	5.15
No. 26	4.60@4.70	5.55	5.50	5.30
No. 28	4.90@5.00	5.85	5.80	5.60

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	48%	34%	55½%	43½%	50%	37%
2½ to 6 in. steel lap welded	44%	30%	53½%	40½%	47%	34%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%, less 5%; class A, plus 23%. Cast iron, standard sizes, 34@5% off.

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ⅛-in. to 1-in., O.D., weighing 0,17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
⅛	$0.09	50%	⅞	$0.16	35%
¼	.11	45%	1	.18	31%
½	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.53	8.00	6.70
Hoop steel	5.19	4.66	4.55
Cold rolled strip steel	7.50	8.25	7.40
Floor plates	5.80	5.66	5.80
Cold drawn shafting or screw	4.40	3.90	4.00
Cold drawn flats, squares	4.90	4.40	4.50
Structural shapes (base)	3.59	3.46	3.30
Soft steel bars (base)	3.49	3.36	3.20
Soft steel bar shapes (base)	3.49	3.36	3.20
Soft steel bands (base)	4.39	3.61	3.95
Tank plates (base)	3.59	3.46	3.30
Bar iron (3.10@3.15 at mill)	3.49	3.36	3.20
Tool steel	11.00	....	....
Drill rod (from list)	55@60%	40@55%	50%

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			14.00
Tin, 5-ton lots, New York			50.00
Lead (up to carlots), St. Louis	7.62½	New York	8.62½
Zinc (up to carlots), St. Louis	6.05	New York	6.75

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	28@29	30.00	29.50
Antimony (Chinese), ton spot	10.00	12.75	13.25
Copper sheets, base	21.25	21.50	23.00
Copper wire, base	16.75	19.25	16.25
Copper bars, base	20.50	22.75	19.50
Copper tubing, base	22.75	27.50	23.00
Brass sheets, base	17.75	22.00	18.75
Brass tubing, base	21.50	27.00	20.50
Brass rods, base	15.50	18.00	15.75
Brass wire, base	18.25	22.00	....
Zinc sheets (casks)	10.75	11.00	....
Solder (½ and ½), (case lots)	39.00	34.50	31.50
Babbitt metal (83% tin)	60.00	63.00	52@56
Babbitt metal (35% tin)	28.00	20.00	25@28
Nickel (ingot and shot) f.o.b. refinery	27.00	....	....
Nickel (electrolytic) f.o.b. refinery	30.00	....	35.00
Nickel (F shot) f.o.b. refinery	30.00	....	....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b Huntington, W. Va.:

Rolled nickel sheet (base)	52.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Shop Materials and Supplies

METALS—Continued

Manganese nickel hot rolled rods "E"—low manganese (base) 54. 00
Manganese nickel hot rolled rods "D"—high manganese (base) 57. 00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32. 00	Hot rolled rods (base)	40. 00
Blocks	32. 00	Cold drawn rods (base)	48. 00
Ingots	38. 00	Hot rolled sheets (base)	42. 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.50@11. 00	11. 50	11. 25
Copper, heavy, and wire	10.00@10. 75	11. 00	10. 50
Copper, light, and bottoms	8.00@9.75	10. 00	9. 50
Lead, heavy	7. 12½@7. 75	7. 00	7. 50
Lead, tea	4.00@6. 50	4. 50	6. 50
Brass, heavy, yellow	5. 37½@7. 00		6. 75
Brass, heavy, red	7. 62½@9. 25	10. 00	9. 00
Brass, light	4. 62½@6. 00	6. 00	6. 25
No. 1 yellow brass turnings	5. 12½@7. 00	6. 50	6. 75
Zinc	3. 62½@4. 00	3. 50	3. 75

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$24. 30	$22. 85	$18. 50
"A" Grade:				
IC,	20x28, 112 sheets	20. 20	18. 00	17. 00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	14. 00	13. 00	14. 50
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	8. 25	6. 55	7. 40

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0. 14@0. 21	$0. 20	$0. 14
Cotton waste, colored, per lb.	. 09@. 12½	. 17	. 10½
Wiping cloths, 13¼x13¼, per lb	11. 75	36. 00 per M	. 16
Wiping cloths, 13¼x20½, per lb.	....	52. 00 per M	. 16
Sal soda, per 100 lb.	2. 40	2. 25	2. 65
Roll sulphur, per 100 lb.	3. 60	3. 50	3. 50
Linseed oil, per gal., 5 bbl. lots	. 95	1. 08	. 94
Lard cutting oil, 25% lard, per gal.	. 55	. 50	. 79*
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.29	. 35	. 40
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 2c. per sq.in., per ply:			
Medium grade	40–2½%	30–10%	30–10%
Heavy grade	30–5%	30%	20–5–2½%
Rubber and duck:			
First grade	50%	50–10%	40–10%
Second grade	50–5%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in.,			
No. 1 grade, per ream of 480 sheets:			
Flint paper	$5. 40	$5. 84	$6. 48
Emery paper	9. 90	11. 00	8. 80
Emery cloth	31. 12	31. 12	29. 48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1. 49	1. 24	1. 40
Cloth	3. 38	2. 67	3 20
Fire clay, per 100 lb. bag		. 65	. 60
Coke, prompt furnace, Connellsville	per net ton		3. 75@4. 00
Coke, prompt foundry, Connellsville	per net ton		4. 75@5. 50
White lead, dry or in oil	100 lb. kegs		New York, 15. 00
Red lead, dry	100 lb. kegs		New York, 15. 00
Red lead, in oil	100 lb. kegs		New York, 16. 50

*Chicago quotes on pure lard oil, No. 1 grade.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0349	$0.0354	$0.0334
Cold finished shafting	per lb.	0.044	0.044	0.042
Brass rods	per lb	0.155	0.16	0.20
Solder (½ and ½)	per lb.	0.39	0.39	0.34
Cotton waste	per lb.	.14@.21	.14@.21	.10@.13
Washers, cast iron (½ in.)	per 100 lb.	6.50	6.50	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.02
Lard cutting oil	per gal.	0.55	0.58	0.55
Machine oil	per gal.	0.29	0.29	0.297
Belting, leather, medium	off list	40–2½%	40–2½%	30–10%
Machine bolts up to 1x30 in.	off list	45%	45%	30%

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	45%	60%	55–5%
1½ and 1½x3 in. up to 12 in	15%	50–5%	50%
With cold punched hex. nuts up to 1 in. diam. (plus std. extra of 10%)	30%	$3. 50 net	
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	35%	3. 50 net	$4. 00 off
Button head bolts, with hex. nuts	List net	List net	3. 50
Hex. head and hex. nut bolts	List net		List plus 10%
Lag screws, coach screws	45%		50-5%
Square and hex. head cap screws	75%	75%	75–5%
Carriage bolts, up to 1 in.x30 in.	35%	05%	50–5%
Bolt ends, with hot pressed nuts	45%		55-5%
Tap bolts, hex. head, list plus	35%		
Semi-finished nuts, ⅜ and smaller	65%		
Semi-finished nuts, ½ and larger	60%	70%	80%
Case-hardened nuts	50%		
Washers, cast iron, ½ in., per 100 lb. (net)	$6. 50	$4. 00	$4. 00
Washers, cast iron, ⅜ in., per 100 lb. (net)	5. 50	4. 00	4. 00
Washers, round plate, per 100 lb. Off list	1. 50	4. 00	4. 00
Nuts, hot pressed, sq., per 100 lb. Off list	1. 00	3. 50	3. 50
Nuts, hot pressed, hex., per 100 lb. Off list	1. 00	3 50	3. 50
Nuts, cold punched, sq., per 100 lb. Off list	1. 00	3. 50	3. 50
Nuts, cold punched, hex., per 100 lb. Off list	1. 00	3. 50	3. 50
Rivets:			
Rivets, ⅞ in. dia. and smaller	50%	60%	60%
Rivets, tinned	50%	60%	4½c. net
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb. (net)	$5. 00	$3. 60	$3. 75
Cone heads, ditto (net)	5. 20	3. 80	3. 95
1½ to 2-in. long, all diameters, *EXTRA* per 100 lb.	0. 25		0. 15
¾ in. diameter *EXTRA*	0. 35		0. 15
½ in. diameter *EXTRA*	0. 75		0. 50
1 in. long, and shorter *EXTRA*	0. 75		0. 50
Longer than 5 in. *EXTRA*	0. 50		0. 25
Less than 200 lb. *EXTRA*	0. 50		0. 50
Countersunk heads *EXTRA*	0. 45		$4. 20 base

New and Enlarged Shops

Machine Tools Wanted

Mass., Worcester—Star Auto Radiator Repair Wks., 32 Derby St.—upright drill; 12 in. x 6 ft. lathe; punch for ½ in. plate; tinsmiths and miscellaneous automobile repair tools.

Minn., Tracy—T. Hensen (contractor)—one 2,000 lb. pile hammer with nippers; portable bar bending machine (used).

N. Y., Albany—W. L. Schupp Co., Quail St.—complete machine tool equipment for garage.

N. Y., Buffalo—M. Fierstein, 258 William St.—equipment for repairing ornamental iron.

N. Y., Buffalo—Hondaille Co., 1400 West Ave. (manufacturer of shock absorbers), J. A. Graham, Vice-Pres.—equipment for the manufacture of covers for auto springs.

N. Y., Otego—Sweets Garage—garage tools, also air compressor, motor or belt drive.

Tenn., Chattanooga—C. G. Walden, 1410 Cowart St.—lathe, drill press, grinder and reboring machine for automobile repair station.

Wis., Ingram — Genl. Corp. of Ingram (garage and machine shop), E. J. Sharrow, Purch. Agt.—drill presses, air compressor, gasoline pumps, tanks and electric drill.

Ont., Bracebridge—Smith & Croucher—lathe and upright drill for repair and machine shop.

Ont., Coldwater—C. Galbraith—equipment for garage and repair shop.

Que., Montreal—P. Bisaillon, 477 St. Emilie St.—complete equipment for garage and automobile repair shop, also gas tank and free air equipment.

Que., Montreal—Neutrodyne Radio Sets, Ltd., c/o J. C. Martineau, 90 St. James St.—machinery and equipment for the manufacture of radio sets and appliances.

Machinery Wanted

Calif., San Francisco—M. J. Lyon, Archt., 916 Kearny St.—mill-rock crushing plant for San Diego.

Md., Baltimore—Baltimore Copper Smelting & Rolling Co., Canton St.—9 to 13 roll straightener, for 24 and 30 in. material.

Mass., Quincy—J. H. Taylor, 91 Holmes St.—furnaces, conveying systems, etc., for proposed $25,000 foundry.

Mich., Wyandotte — Williamson Lumber Co.—electrically operated machinery for proposed $70,000 addition to lumber mill.

Mo., St. Louis—H. V. Jecmen, 2417 South 18th St. (woodworking)—circular saw, medium size.

N. Y., Binghamton—Binghamton Refrigerating Co., Inc., 45 Lathrop Ave., C. A. Ball, Purch. Agt.—refrigerating equipment.

N. Y., Buffalo—Meyer & Schnellberger, 66 Oak St., F. Meyer, Purch. Agt.—machinery for printing plant.

N. Y., Granville—H. G. Williams Slate Co.—two roll crushers for secondary reduction of slate; 500 ft. 6 in. 6 ply and 250 ft. 4 in., 5 ply rubber belt; one chain bucket elevator.

N. Y., Malone—Sulham Mfg. Co. (lumber, etc.)—heavy duty bandsaw for logs.

N. Y., Schuylerville—T. Brown, R. D. 2—planer and matcher for lumber mill.

N. Y., Sherrill—Oneida Community, Ltd. (manufacturer of silverware)—polishing equipment.

O., Columbus—H. & H. Supply Co., Reynolds Ave. (building supplies), H. Yloche, Mgr.—loading and unloading equipment.

O., Columbus—H. Holtzman & Sons Co., 2050 East Main St. (manufacturer of furniture), C. E. Holtzman, Secy.—woodworking machinery, including one medium planer and one cutoff saw.

Pa., Waynesboro—Frick Co. (manufacturer of ice machines)—one 5 to 7 ton electric crane, 80 ft. span for foundry stock yard.

Pa., Williamsport — Bd. Educ., H. A. Sterner, Secy.—receiving bids until May 5 for variety saw for use as ripsaw, Tannewitz type, motor driven or equivalent.

Tex., Lometa—W. Rogers—over $10,000 worth of saw mill machinery.

Wis., Crandon — Laird-Davis Excelsior Co., E. Laird, Purch. Agt.—special machinery for the manufacture of excelsior.

Wis., La Crosse — Commercial Mfg. Co., c/o O. Wostal, 717 Jackson St. (manufacturer of automobile accessories)—polishing machines and emery grinders.

Wis., Milwaukee—Milwaukee Cabinet Co., 1239 9th Ave., T. Dembinski, Purch. Agt.—dry kiln machinery.

Wis., Oshkosh—Goettmann Printing Co., 38 Main St.—printing presses, paper cutting machine, etc., for proposed $40,000 print shop.

Wis., Polar—Polar Dairy Products Co., J. Groth, Purch. Agt.—refrigeration machinery, about 5 ton.

Every one of these items is reported by our authorized correspondents who are instructed to verify every item sent in. This free weekly service is published in the interests of the buyer and the seller, to bring them together and get machinery moving.

Everything possible is done to insure authenticity and timeliness.

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BUSINESS NEWS DEPARTMENT
Tenth Ave. at 36th St., New York

Wis., Racine—Belle City Malleable Iron Co., Kewaunee St.—electric furnace and traveling crane.

Alta, Calgary—Nectars, Ltd., H. G. Kemp, Mgr. (mineral waters, etc.)—complete bottling equipment.

N. S., Halifax—Mitchell & McNeil, Ltd., C. F. Tremaine, Purch. Agt.—equipment for canning, packing and curing plant.

Ont., Beaverton—T. Doherty (planing mill)—buzz planer and matcher.

Ont., Emsdale—A. Bilz—dragsaw and blower for sawmill.

Ont., Gravehurst—J. W. Borneman (manufacturer of boats, etc.)—bench planer and other equipment.

Ont., Huntsville—L. Hill (planing mill)—planer and bandsaw.

Ont., North Augusta—I. Mallory (sawmill)—swing cutoff saw, self feed ripsaw, etc.

Ont., Sprucedale—M. Dean & Bros. (sawmill)—swing cutoff saw and drag saw.

Ont., Toronto—G. H. Broughton Co., 126 Wellington St., W.—photo engraving machinery and equipment.

Que., Onslow Corners—J. M. Hodgins (sawmill)—traveling carriage saw and drag saw.

Que., Ste. Cecil de Masham—E. Legros (sawmill)—log saw, traveling carriage saw and bandsaw.

Metal Working Shops

Calif., Oakland—The Magnavox Co., 2735 East 14th St., manufacturer of sound magnifiers, awarded the contract for the construction of a 1 and 2 story factory. Estimated cost $50,000.

Calif., San Bernardino — The Atchison, Topeka & Santa Fe Ry. Co., Kerckhoff Bldg., Los Angeles, awarded the contract for the construction of a 180 x 220 ft., unit 4, addition to machine shops, here.

Calif., San Francisco—H. E. Holmes, 774 Folsom St., is having plans prepared for the construction of a 1 story automobile repair shop on 7th St. Estimated cost $45,000. P. Righetti, 12 Geary St., Archt.

Ill., East St. Louis—The East St. Louis Steel Castings Co. awarded the contract for the construction of a 1 story foundry. Estimated cost $40,000.

Kan., Fort Scott—The Missouri-Pacific R.R., Railway Exch. Bldg., St. Louis, Mo., plans to rebuild its 1 and 2 story tin and machine shops, etc., which were recently destroyed by fire, here. Estimated cost $200,000. E. A. Hadley, Ch. Engr.

Ky., Louisville — The Reo-Spaulding-Kelley Co., 210 East Bway, awarded the contract for the construction of a 2 story, 57 x 200 ft. garage and sales room. Estimated cost $150,000. Noted Apr. 17.

Mass., Quincy—J. H. Taylor, 91 Holmes St., will build a 1 story, 50 x 100 ft. foundry. Estimated cost $25,000.

N. Y., Hornell—The Erie R.R. Co., 50 Church St., New York, will build a wheel repair shop, here. Cost between $50,000 and $75,000.

N. Y., New York—B. J. Catts, c/o Block & Hess, Engrs. and Archts., 18 East 43rd St., is having preliminary plans prepared for the construction of a 5 story, 100 x 100 ft. garage on East 55th St.

N. Y., New York—Charles & Co., 48 East 43rd St., awarded the contract for the construction of a warehouse and garage on 1st Ave. and 44th St. Estimated cost $750,000. Noted Feb. 21.

O., Cleveland—The C. O. Bartlett & Snow Co., French and Winter Rds., manufacturer of elevating and conveying machinery, is having plans prepared for the construction of 1 and 2 story, structural machine and pattern shop, etc., on Harvard Ave. Estimated cost $175,000. Allen-Osborn Co., Rose Bldg., Archts.

O., Cleveland—The Cadillac Co., 1935 Euclid Ave., is having plans prepared for the construction of a 10 story, 84 x 200 ft. sales room and office, 4 story, 84 x 200 ft. and 92 x 300 ft. service and store buildings. Estimated cost $1,500,000. T. H. Towell, Pres. W. S. Lougee, Marshall Bldg., Archt.

O., Cleveland — The Ohio Machine & Boiler Co., 1501 University Rd., awarded the contract for the construction of a 1 story, 64 x 100 ft. factory. E. F. Simon, Genl. Mgr. Estimated cost $40,000. Noted Apr. 17.

Pa., York—The United States Chain Co. awarded the contract for the construction of a 1 story, 60 x 200 ft. addition to its plant.

Wis., Racine—The Belle City Malleable Iron Co., Kewaunee St., awarded the contract for the construction of a 1 story, 117 x 306 ft. second unit of foundry. Estimated cost $80,000. Noted Jan. 17.

Wis., Racine—The Wisconsin Metal Products Co., 16th and Ann Sts., awarded the contract for the construction of a 1 story, 98 x 246 ft. factory. Estimated cost $60,000. Noted Mar. 27.

Wis., South Milwaukee—The Bucyrus Co. awarded the contract for the construction of a 1 story, 30 x 100 ft. tool room. Estimated cost $40,000.

Wis., West Bend—W. Warnkey, Main St., is receiving bids for the construction of a 2 story, 40 x 70 ft. sheet metal working shop. Estimated cost $40,000. Federal Eng. Co., 444 Milwaukee St., Milwaukee, Engrs. Noted Apr. 17.